ADVANCED ACADEMIC DEGREE INVENTORY MANAGEMENT (AADIM) MODEL

THESIS

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Abstract

This research develops the Advanced Academic Degree (AAD) Inventory Model (AADIM) to employ an inventory management approach to select, educate, and assign officers to duties that require incumbents possessing advanced education in specialized technical disciplines. The AADIM offers an alternative approach to the US Air Force's current billet-based Graduate Education Management System (GEMS).

The entry model (AADIM-E) generates, via user inputs, a career field specific advanced education profile and then employs a Markov model to forecast the educational quotas necessary to achieve the desired profile within a prescribed period of time. The utilization model (AADIM-U) uses an additive multi-attribute value function to ascribe a qualification score, based on a selected set of weighted criteria, to each officer with respect to each available duty assignment. An integer programming formulation is then solved to obtain an optimal matching between officers and assignments that maximizes the summed qualification scores.

The research demonstrates that AADIM-E can be used to evaluate the feasibility and practicality of long-term policies such as career field manning, the desired proportion and timing of officers requiring advanced education, as well as the length of time allowed to achieve such goals. The AADIM-U yields an objective methodology to manage AAD officers, as long-term inventory assets, to yield substantially greater incumbency rates for AAD positions than historically achieved using the current GEMS process.

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ADVANCED ACADEMIC DEGREE INVENTORY MANAGEMENT (AADIM) MODEL

I. Introduction

Hundreds of military officers receive graduate degrees sponsored by the US Air Force each year. These officers are released from their current assignments and are allowed to pursue a graduate degree related to their career field for a period of one to three years. Graduate education is costly and requires officers to be away from their duties for an extended period of time, hence the Air Force requires a system that systematically manages these programs to ensure that military officers receive the graduate education that is related to their typical duties, and that this education is effectively utilized.

Problem Background

AFI 36-2302, *Professional Development (Advanced Academic Degrees and Professional Continuing Education)*, establishes the Graduate Education Management System (GEMS), a billet requirement process used to review and certify requirements biannually from major commands (MAJCOMS) and then forward the requirements to Air Force Academic Specialty Monitors (ASMs). ASMs are responsible for reviewing, certifying, and prioritizing the current listing of AAD billets and act as a point of contact for organizational and unit functional managers. The Air Force Education Requirement Board (AFERB) reviews the Advanced Academic Degree (AAD) requirements and approves those that are within available funding levels and prioritizes all requirements below available funding as an alternate list. The Air Force Personnel Center (AFPC) takes these quotas and advertises educational opportunities to Air Force personnel. Selected personnel then attend the Air Force Institute of Technology (AFIT) or other

graduate institutions to obtain an AAD. Once the degree requirements are fulfilled, graduates then serve a three year payback tour in an AAD-coded billet (4:3-5).

GEMS does work well to justify educational requirements for graduate programs. The requirements are generated at the lowest level where it is easy to identify the need for positions that require officers with an AAD. The projected vacancies then become the basis for graduate education quotas that provide an easy and convenient method to measure incumbency rates and graduate education requirements. However, GEMS has significant shortcomings.

First, GEMS is not designed to develop officers professionally. Requirements for graduate education are billet driven which implies that an officer only has the opportunity to attend a graduate program if there is a projected billet vacancy. Therefore, officer development takes a secondary role. Furthermore, following an AAD officer's reassignment, AAD billets often remain vacant for a period of time until a replacement officer is available to be assigned to that billet. Since AAD billets can only be filled by officers possessing a matching AAD code, commanders often delete the AAD coding from these billets, rather than leave AAD billet vacant.

It has been seen that the "Bottom-Up" approach can be problematic. For example, in the billet recertification process, MAJCOMS use widely varying standards, resulting in inconsistent education requirements. Further, despite accountability, GEMS does not adequately achieve or monitor program goals. Several audits over the last decade have shown that the historical billet incumbency rate is only about 50-60% (17:1). One cause is that AAD officers often move to other positions within an organization,

leaving the original AAD billet vaccant. This results in no record of the having served the full 36 month active duty post-education AAD commitment.

Research Approach

There has been a shift in Air Force culture over the past few years towards focusing on the overall development of officers throughout their career, not for just the next assignment. The billet-based system does not sufficiently support the current developmental education initiatives. The developmental education initiatives provide a unique opportunity to develop a grand strategy for the Air Force graduate education program. Development Teams (DTs), who are the primary advocates for officer development in a career field, are centralized teams with representatives from a cross section of the Air Force who help manage the long term health of each officer as well as the career field the DTs represent.

The aim of this research is to develop tools to help manage the developmental education of officers more efficiently and also to help improve the utilization of officers who have an advanced academic degree. The proposed models, shown in Figure 1, utilize the career field managers (CFT), and associated Development Teams, as a centralized authority for identifying and implementing graduate education requirements.

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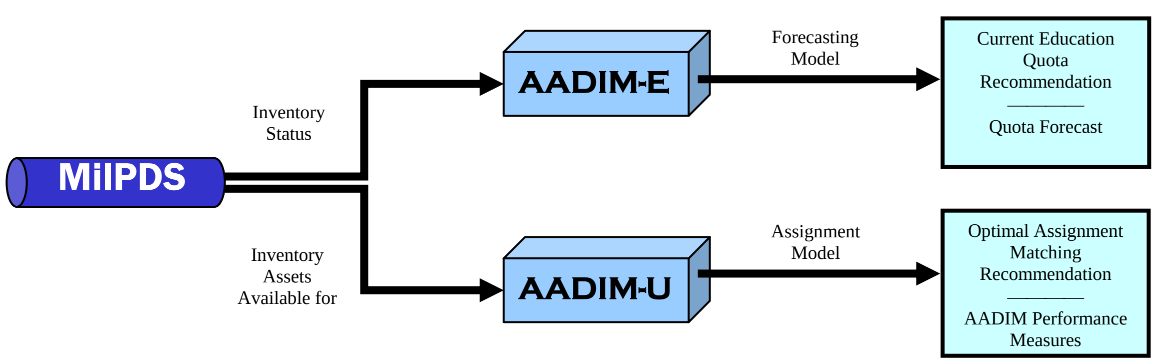

Figure 1: Flow Chart of AADIM

The first model, the Advanced Academic Degree Inventory Model – Entry (AADIM-E), defines an AAD inventory partitioned by commissioned years of service (CYOS) and a user-defined idealized educational profile to generate a snapshot of the current "health" of any given career field. A Markov model is developed from historic AAD officer data to forecast the number of officers who are expected to remain within the AAD inventory. The difference between the forecasted AAD inventory and the idealized educational profile for each CYOS group are then used to calculate future educational requirements needed to maintain the aggregate idealized educational percentage.

The second model, the Academic Degree Inventory Model – Utilization (AADIM-U), determines an optimal assignment matching recommendation for AAD officers. We develop a multi-attribute value function that is used to obtain a qualification score for each officer, with respect to each potential assignment, based on a selected set of qualification criterion. We then develop an integer assignment problem formulation, with maximizing the summed qualification scores as the objective, to obtain an optimized matching between AAD inventory officers and AAD-coded assignments.

Overview of Subsequent Chapters

We begin in Chapter 2 by discussing the relevant Department of Defense Directives and Air Force Instructions that regulate the Air Force graduate education system. Next, we review the literature pertinent to human resource planning that will be used to develop AADIM.

Chapter 3 details the methodology used to construct AADIM-E and AADIM-U. We outline the AADIM-E by first describing how to generate a notional career field

idealized education profile, and then develop the Markov model used to forecast the number of officers who remain part of the AAD inventory. For AADIM-U, we outline the assignment problem used to find the optimal matching of AAD officers to AAD assignments and the multi-attribute value function used to calculate qualification scores.

In Chapter 4, we discuss the results for each model. We use historic end-of-fiscal year data from the 61S and 13S career field for AADIM-E to evaluate the model. Then, for AADIM-U, we use notional 61S career field data to construct a data file that demonstrates the capabilities to effectively assign officers to billets in AADIM-U. In Chapter 5, we summarize the research and recommend future avenues for research.

II. Literature Review

Introduction

In this chapter, we review the literature pertaining to this research. In the first section, we discuss the relevant Department of Defense and Air Force documents, and in the second section we discuss two types of Human Resource Planning; human resource forecasting and manpower planning, as well as operations research (OR) methods that can be used to address each type of problem.

Current Advanced Academic Degree Policy

The policy for managing the AAD program can be found in two Air Force instructions (AFI), AFI 36-2302 and AFI 36-2640. Both AFIs get direction for managing the AAD program from Department of Defense Directive (DODD) 1322.10. DODD 1322.10, *Policy on Graduate Education for Military Officers*, establishes "policy, responsibilities, and procedures for graduate education for military officers." (19:1) This directive gives each military service the ability to educate their forces to successfully meet their mission requirements. Each service must validate positions that require an advanced academic degree and review those validated positions biennially. Officers who have obtained an AAD degree must also be tracked and assigned to validated positions when possible. DODD 1322.10 directs that all services should "continually evaluate the process of managing officers with graduate degrees, including the methodologies for determining requirements through the validation of positions and the degree to which officers who have received fully- or partially-funded graduate educations are utilized in validated positions." (19:2)

The overarching purpose for graduate education of military officers, as put forth in paragraph 1.2 of DODD 1322.10, is to "raise the levels of individual military officer professionalism and technical competence. . ." (19:1). The directive further acknowledges that professional growth opportunities provided via advanced education opportunities are a key incentive for retaining highly qualified officers. However, it can be well argued that the remainder of the directive contradicts this intent by establishing a billet-based system to determine education requirements. This approach is more akin to training rather than education. Officer development therefore takes a secondary role under this billet system.

An audit conducted in 1992 by the Department of the Air Force investigated the management of advanced education and training programs (17:1). The audit concluded that advanced education programs were managed well except for the post-education utilization of AAD officers. On average, an officer spent 1.25 years in an AAD-coded follow-on assignment versus the mandatory 3 years. The audit report recommended cutting the number of graduate students by 58% for fiscal years 1995-1998.

On 6 November 2002, the *Chief's Sight Picture* called for a new direction for development, both educationally and professionally, for all Air Force officers (13:1). AFI 36-2640 executes the Chief of Staff's vision of Total Force Development.
AFI 36-2640, *Total Force Development (Active Duty Officer)*, documents the "overarching leadership philosophy of developing active duty officers and their respective career fields at the strategic, operational, and tactical levels." (5:1)
AFI 36-2302 has been the official guidance on professional education since 11 July 2001, but GEMS remains the primary process for managing professional education.

AFI 36-2640 establishes Development Teams (DTs) for each functional area to manage and oversee officer professional development, including education, by "providing input into the developmental education (DE) selection process." (5:9) The DT uses the Officer Development Plan (ODP) which replaces the Preference Worksheet (PW). The ODP is completed by each officer, and the appropriate DT reviews each ODP and assigns a "vector" to each officer's ODP. Table 3 lists the vectors the DTs select to indicate the type of assignment that best matches the officer's career plan. Note that an assignment vector is not an assignment match, but rather a recommendation used by the Assignment Team who assigns officers to billets (18:2).

Table 1: Assignment Vector Recommendations (18:2)

Assignment Vectors	
JCS	Deputy Group Commander
Air Staff	Squadron Commander
Joint Other	Operations Officer
MAJCOM Staff	Developmental Assignment
FOA/DRU	Political-Military/FAO
NAF/SPO/Center	Developmental Education
AF-level Instructor Duty	Crossflow (permanently change Core AFSC)
Wing/Base Duty	Needs of the Air Force

The introduction and formulation of Total Force Development has restructured how education, training and assignment processes are conducted in the Air Force. GEMS does not address the Development Team's role in professional education. An updated version of AFI 36-2302 is not expected until Fall 2005 (2:1). The current GEMS process is not intended to be phased out, but instead adapted to reflect the changes that have occurred in the current Air Force climate.

Human Resource Planning

Human Resource Planning (HRP) involves "determining the number of personnel and their skills that best meet the future operational requirements of an enterprise" (21:65). HRP uses a variety of OR techniques and applies them to solving problems within various types of organizations. For example, Caron *et al*. (12:449) investigated daily shift scheduling for nurses in a hospital by using a network flow formulation, and Geerlings *et al*. (24:1) looked at using discrete simulation to forecast manpower levels of the Royal Netherlands Navy over several years.

These examples demonstrate that two different tasks can be readily found in HRP: human resource forecasting and manpower planning. Human resource forecasting focuses on long term planning of personnel in an organization and addresses the questions like "how many" and "what kind" of personnel are needed over several years. Conversely, the focus of manpower planning is the allocation of available personnel within the next several weeks or months (24:2). Simulation, Markov models, and forecasting methods are the most common OR techniques used to solve HR forecasting problems. Multi-objective linear programs (MOLP) and network flow models are generally used to find solutions to manpower planning problems.

Human Resource Forecasting

For large scale organizations, such as the U.S. Air Force, there are several difficulties in trying to determine the proper mix of job skills for personnel. First, as an organization grows in size, the differentiation of jobs required to execute the mission increases. Second, military members often transition to other career fields, leave the service, receive a promotion, or change assignments frequently, making it difficult to

determine the actual state of the workforce (21:66). Despite these difficulties, techniques to model and predict the future of organization's personnel levels have been developed to account for such complexities.

Two methods we explore in this section are Markov models and forecasting models. Both have been studied and often applied by various organizations within the military and government. One common theme in the literature concerning both techniques is the general structure of the human resource forecasting problem. Schank *et al*. (32:19-20) introduces the aggregated equation to predict the inventory levels of personnel,

$$\textit{Future Strength} = \textit{Current Strength} + \textit{Gains} - \textit{Losses}. \qquad (1)$$

The future strength will depend on the strength of the force in the current period, plus the forecasted gains, minus the forecasted losses. This equation can be partitioned to capture more details in the system being modeled (32:19), by disaggregating gains and losses using variables such as grade. For example,

$$\textit{Future Strength} = \textit{Current Strength} + \textit{Grade Gains} - \textit{Grade Losses}. \qquad (2)$$

Another approach is to disaggregate the current strength by considering promotions and demotions in the system (26:7), that is,

$$\textit{Future Strength} = \textit{Current Strength} + \textit{Promotions} - \textit{Demotions} + \textit{Gains} - \textit{Losses}. \qquad (3)$$

Disaggregated data is often useful to decision makers to be able to see the workforce broken out by factors such as pay grade or years of service to better identify

shortfalls and overages in the workforce. However, greatly disaggregated data requirements increase the model's complexity and run time, and data for the disaggregated variables may be difficult to collect.

Markov Models

One method of forecasting the state of a workforce is by using transition rates (29:35). For example, military officers are "birthed" into military service with zero commissioned years of service (CYOS) and progress through the system until they "die" by separating or retiring from the military. This idea of a birth and death process is more commonly referred to as a Markov Process (11:6). Markov models can be used to determine the state of the system in the future given the initial state of the system and the rates at which elements move from one state to another.

Brown describes a Markov decision process model using a dynamic linear programming technique, to determine the minimum number of officers by grade and academic specialty code needed to be educated at AFIT to fill vacant AAD billets (11:6). The resulting Quota Allocation Model (QuAM) uses Markov modeling concepts to setup a linear optimization program that has over 125 different constraints. The attrition probabilities for the QuAM model are determined by current longevity and degree level. The inputs into the system include attrition probabilities for officers with different years of service and degree levels, requirements for officers with certain degree levels and grades, and an inventory factor for each degree level. The linear program then solves for the minimum number of officers who need to obtain an AAD to fill the available billets. The QuAM model's purpose is to satisfy billet requirements, and hence does not consider the overall educational characteristics of the various officer career fields. For example, if

billets for a particular career field are reduced, as has been the case for the 13S career field, then the QuAM model will only recommend educating a very small number of officers. This contradicts the current intent of Force Development's emphasis on building a more educated Air Force.

A Markov model, instead of a Markov decision process model, can also be used to solve the human resource forecasting problem. Recall that only the initial state of the system and transition rates are needed to forecast future personnel inventories. As is common in many organizations, percentages are used to describe a variety of rates such as promotion and attrition rates (10:30). These rates, or probabilities, p_{ij}, can be represented in a matrix, $P = [p_{ij}]$, called a one step transition probability matrix, and if the transition probability matrix satisfies

$$p_{ij} \geq 0 \; \forall \, i \;\text{ and }\; \sum_{j=1}^{n} p_{ij} = 1, \tag{4}$$

then the system is considered a stochastic system. Two key assumptions that underlie a Markov process are that elements occupy only one state at a time as they move through the system and all elements in the system are identical and behave independently of one another (29:17).

A $(n + 1)$ x $(n + 1)$ transition probability matrix, P, can be constructed for an organization that has n different states. The $(n + 1)^{st}$ state is used to represent all other states that exist outside the modeled system. This additional state has two purposes. It is the state from which new employees are hired, and to which employees move when they leave an organization. The transition probability matrix can be partitioned as

$$P = \left[\begin{array}{c:c} Q & w' \\ \hdashline p & 0 \end{array}\right], \tag{5}$$

where

w' = (n x 1) attrition column vector,
Q = (n x n) matrix representing movement within the inventory, and
p = (1 x n) recruitment row vector.

If we denote the beginning inventory at time n as x_n, then the equation

$$x_{n+1} = x_n Q^{n+1} + x_n w' p^{n+1} \tag{6}$$

is analogous to the general human resource equation. Furthermore, if the transition rates of Q are assumed to be constant, then we can use the alternative equation,

$$x_n = x_0 + \prod_{i=1}^{n} \left(Q + x_n w' p^i\right), \tag{7}$$

to determine the state of the organization's workforce. This allows the recruitment matrix to be a function of time, allowing managers to explore various recruitment strategies (10:38). However, the drawback to Equation (7) is that the model recruits only the number of personnel who exited from the organization during time i, hence the model only works well for organizations that are interested in maintaining current manning levels.

Markov models have been useful in forecasting US Army personnel levels over a 20 year period (21:67). The success of using a Markov model depends on a properly built model and accurate transition rates. Military models have a distinct advantage over civilian models since the military is a closed system (11:7). However, accurate transition

rates can be difficult to calculate for large scale problems, and transition rates change over time and have to be adjusted periodically.

Forecasting Methods

Another approach to human resource forecasting described in the literature is forecasting methods. Explanatory and time series are the two major types of forecasting methods that can be used to develop forecasts (30:10-12). Explanatory forecasting assumes that there is an explanatory relationship between a response and one or more independent variables. This method of forecasting uses linear and nonlinear regression models to explain the relationships between the independent and dependent variables. Unlike explanatory forecast methods, time series forecasting develops forecasts using either moving averages or exponential smoothing methods to construct forecasts from the historical data.

Hoffman (26:7) used a regression approach to forecast the civilian personnel at National Security Agency (NSA) for multiple years. The general equation used to forecast civilian personnel strength from year to year was:

$$\begin{gathered} \textit{Future Strength} = \textit{Current Strength} - \textit{Basic Losses} - \textit{Policy Losses} - \textit{Migrations} \\ + \textit{Promotions} + \textit{New Hires}. \end{gathered} \tag{8}$$

The equation is a disaggregation of the general human forecasting problem. The current strength and losses are disaggregated to include promotions and two types of losses, basic and policy. A time series forecasting method could have been used but the author opts to use a regression model. The standard form of a multiple linear regression is

$$Y = b_0 + b_1 X_1 + b_2 X_2 + \cdots + b_n X_n \tag{9}$$

where Y is the forecasted value and $X_1, X_2, \ldots, X_n$ are the explanatory variables. A regression model is useful as a forecasting technique. Sensitivity analysis can be performed on the explanatory variables to investigate the effects each has on the forecasted value. This can be useful for a decision maker who wishes to influence or control a process such as hiring and firing of employees (30:186).

Regression models do have drawbacks. Explanatory variables may not exist or data is difficult and/or costly to collect. Determining the number of explanatory variables to include in the model can present a challenge. If too few variables are added to the model, then the forecast might not be accurate and if too many are placed in the model, the model tractability is reduced. Regression models assume that the explanatory variables used are external to the actual system being modeled.

Econometric models are regression models that allow several interdependent variables to be used in a single model. Econometric models are considered to be robust and able to handle interdependencies between the factors that normal linear regression can not handle. Econometric models are often costly and specific to a particular organization making them often inappropriate for application to other organizations (30:299-302).

The Enlisted Inventory Loss Model (ELIM), employed by the U.S. Army to manage enlisted inventory, uses the formulation of Equation (1) to forecast the inventory levels for five years (32:20). Historical data is used to calculate rates and factors for various groups within the U.S. Army. Several techniques are available, but exponential smoothing, a time-series forecasting method, is often used to forecast the rates and factors. Exponential smoothing is one of the most popular and widely used techniques in

short-term forecasting (32:89). Other techniques are often discussed in the literature, such as moving averages, but are not implemented due the superiority of exponential smoothing techniques (30:145-146).

The single exponential smoothing forecast is determined by the following equation:

$$F_{t+1} = \alpha Y_t + (1-\alpha) F_t \,. \tag{10}$$

The forecast, for the next time period, F_{t+1_t}, is based on the most current observation, Y_t, the current forecast, F_t, and a weighting factor, α, which has a value between 0 and 1. The single exponential formula can be restated as

$$F_{t+1} = F_t + \alpha (Y_t - F_t) \,. \tag{11}$$

It is easily seen that the forecast is just the previous forecast plus an adjustment. The adjustment is the error, $Y_t - F_t$, multiplied by α. If a large adjustment is needed to correct the forecast, then α will approach one, whereas if a small adjustment is needed, then α will approach zero. Optimal values for α can be found by using methods such as minimizing the mean square error.

Simple exponential smoothing technique assumes that there are no trends or seasonality in the data (30:147-155), but extensions of the single exponential smoothing method can be used. Holt's linear exponential smoothing technique and Holt-Winter's trend and seasonality method are often used.

The Holt linear exponential smoothing model uses two smoothing parameters, α and β, and three equations to forecast data, i.e.,

$$L_t = \alpha Y_t + (1-\alpha)(L_{t-1} + b_{t-1}), \tag{12}$$

$$b_t = \beta(L_t - L_{t-1}) + (1-\beta)b_{t-1}, \text{ and} \tag{13}$$

$$F_{t+m} = L_t + b_t m \tag{14}$$

where

α, β = smoothing parameters,
L_t = estimate of the level of the series at time t,
b_t = estimate of the slope of the series at time t,
F_t = the forecasted value at time t,
Y_t = the actual observation at time t and,
m =the number of the period to be forecasted.

Similar to the simple exponential model, α and β take on values between 0 and 1. Equations (12) and (13) estimate the level and slope, respectively, of the time series at time t (30:158). Recall the Holt linear exponential model and Holt-Winter's model are used when trends and seasonality are present in the data, which increases the number of calculations needed to forecast the next time period, but this increase in computation time is acceptable for a more accurate forecast. A visual evaluation of the data plotted against time is usually useful to identify any trends or seasonality, but it is often the case that trends and seasonality are not readily recognizable from a graph (30:171).

Manpower planning

Recall that manpower planning focuses on short-term planning of available personnel. Military manpower planning includes assigning military personnel to their next military assignment. Within the Air Force, there are 28 different officer core specialties. Officers can be assigned to a position within their core career field, to another career field (career broadening), or to developmental education (e.g. Intermediate Developmental Education (IDE)). Given that each of the 70,000 plus officers has many

different viable opportunities for assignment within the U.S Air Force, the job of getting the "right person assigned the right job" is a complex task.

In a RAND study (9:26-28), researchers implemented a linear program to select an optimal mix of civilian and military personnel within an information technology (IT) unit. However, assignment teams encounter multiple objectives that must be met when assigning officers to vacancies. For example, if policy makers decide that maximizing military personnel is important and minimizing cost is also equally important, then Multi-Objective Linear Programming (MOLP) is an option to consider. MOLP implements two or more objective functions instead of one objective function in a linear program. The use of a multi-objective method is useful when trying to minimize/maximize various metrics at one time. Reeves and Reid (31:1234) looked at military manpower planning at the unit level for an Army Reserve unit. The MOLP uses five objective functions to maximize military education, qualifications, mutual support missions, and skill training, and to minimize required training and underachievement of skill training. Another study conducted by Shrank *et al*. (32:164) uses seven different objective functions to identify recruitment and promotion strategies within the U.S. Navy.

A special class of linear programming problems known as network models, has been effective in manpower planning. The objective in a network model is to minimize some type of cost flow, for example, the cost of producing an item or the distance an object travels in a network. In the case of manpower planning, the objective is often minimizing the cost of assigning an officer to a given position. This special case of the transportation problem is referred to as the assignment problem (3:470). The assignment problem is formulated as follows:

$$\text{minimize} \quad \sum_{i}^{m}\sum_{j}^{n} c_{ij} x_{ij} \tag{15}$$

$$\text{subject to} \quad \sum_{j}^{n} x_{ij} \le 1, \forall\, i \tag{16}$$

$$\sum_{i}^{m} x_{ij} \le 1, \forall\, j \tag{17}$$

$$x_{ij} = \begin{cases} 1 \text{ if officer } i \text{ is assigned to assignment } j \\ 0 \text{ otherwise} \end{cases} \tag{18}$$

The constant c_{ij} is the cost of assigning officer *i* to assignment *j*. The first constraint guarantees that each officer in the available pool is assigned to at most one assignment, while the second constraint ensures that each assignment is filled by at most one officer. The classic network model solves the assignment problem with a strong polynomial time bound of $O\left(nm + n^2 \log n\right)$ where *n* is the number of officers and *m* is the number of assignments (3:500).

The assignment of officers to positions requires the officer's qualifications to match with the job requirements. It is unlikely that every officer will be a perfect match for every potential job to be assigned. Caron, *et al*. (12:449) investigated the assignment problem with seniority and job priority constraints. A job qualification score for officer *i* with respect to job *j*, a_{ij}, is included in the problem formulation as:

$$\text{maximize} \quad \sum_{i}^{m}\sum_{j}^{n} c_{ij} x_{ij} \tag{19}$$

$$\text{subject to} \quad \sum_{j}^{n} a_{ij} x_{ij} \le 1, \forall\, i \tag{20}$$

$$\sum_{i}^{m} a_{ij} x_{ij} \le 1, \forall\, j \tag{21}$$

$$x_{ij} = \begin{cases} 1 \text{ if officer } i \text{ is assigned to assignment } j \\ 0 \text{ otherwise} \end{cases} \tag{22}$$

Officer *i* receives a value of 1 for the job qualification score, a_{ij} , if qualified for assignment *j* and a 0 if not qualified. The qualification matrix gives a decision maker the ability to rate officers and find the best officer from the available pool of candidates. Note that when $a_{ij} = 0$, it implies that $c_{ij} = 0$.

More recently, Neural Network models have gained popularity in solving the assignment problem, in particular as an alternative for manpower planning (25:65). Research has concluded that the results and performances are close to simulated annealing but still underperformed more traditional methods used to solve assignment problems. The parallel processing techniques required are not yet in place for neural networks to be practical in manpower planning.

Multiattribute Value Functions

For the $i = 1, 2, \ldots, I$ officers available for reassignment, and $j = 1, 2, \ldots, J$ assignments requiring matches, an I x J dimension qualification matrix, A, can be constructed. Each entry, a_{ij}, represents a qualification score for officer *i* with respect to job *j* as previously discussed. To rate each officer, several different attributes are evaluated to calculate a final score which is then used to rank order a candidate with respect to qualifications. A difficulty in this process is quantifying the decision maker's preference structure where there are several different attributes. In this case, we can use an additive value model to quantify the decision maker's preference structure.

An additive multi-attribute value function can be defined as

$$V(x_1, \ldots, x_n) = k_1 v_1(x_1) + \cdots + k_n v_n(x_n), \tag{23}$$

where there are no interactions among the individual attributes. Additive multi-attribute value functions are the summation of n individual attribute value functions, $v(x_n)$, weighted by constants, k_n, that represent the relative importance of each attribute to the overall value function. Value functions for each attribute transform the decision maker's preference structure into a scalar index of preferability (28:68).

When considering an additive value function, it is important to establish preferential independence amongst the attributes. We say that an attribute, X, is preferential independent of another attribute, Y, if the preferences for an outcome of X do not depend on the level of Y (14:647). This concept allows a decision maker to focus on creating a preference structure for the attribute X while disregarding effects of the attribute Y. It then follows that the individual value functions for X and Y can be evaluated separately (28:109-110).

To formulate a multi-attribute value function, we must first define the individual value functions for each attribute. One commonly used approach is the midvalue splitting technique. First we assign a score of 0 to the last-preferred level of an attribute, say x_0, and a score of 1 to the most-preferred level of an attribute, say x_1. We then proceed to elicit from the decision maker the midpoint value of the attribute, $x_{.5}$, such that $v(x_{.5}) = 0.5$ where $(x_0, x_{.5})$ and $(x_{.5}, x_1)$ are differentially value equivalent. In other words, x_0 is the point where the decision maker is willing to pay the same amount, say z, to go from x_0 to $x_{.5}$ or from $x_{.5}$ to x_1 (28:94). We then proceed to evaluate $x_{.25}$ and $x_{.75}$ in the same fashion to obtain a total of five points for the value function. Once all five points have been assessed, the points are plotted and a curve fitted through the points can be used as a value function for the attribute.

Next, we must determine appropriate weighting constants to create the multiattribute value function, using a swing weighting technique (28:121-122). This method uses a set of two alternatives that are presented to the decision maker for comparison. The first alternative, say *A*, has one attribute set at its most-preferred level while all other attributes are set as their least-preferred levels. The second alternative, say *B*, has a different attribute set at its most-preferred level while the remaining attributes are set at their least-preferred levels. The decision maker then determines the relative value of the two alternatives (e.g., alternative *A* is twice as important as the alternative *B*).

For a set of *n* attributes, the process is repeated using an appropriate set of (n – 1) pairs of alternatives for comparison. Once the decision maker evaluates the comparisons, we then develop a linear system of equations to calculate the values of the weighting constants for the mulitattribute value function.

In this chapter, we reviewed the literature pertaining to this research. We discussed the relevant Department of Defense and Air Force documents and the OR methods that can be used to address the two types of Human Resource Planning. In the next chapter, we will develop the methodology used to construct AADIM-E and AADIM-U using the methods discussed in the literature review.

III. Methodology

Generating a Notional Career Field Educational Profile

Let us begin mapping a notional graduate education profile by examining a typical assignment path for officers, where these officers progress through a series of operations and staff positions over the course of the first ten years of a career as depicted in the decision tree in Figure 2. Each time officers become available for reassignment, some x percent are selected to attend graduate education to obtain a related advanced academic degree (AAD), hence becoming a new entry to the AAD inventory two fiscal years later. This generates a notional educational profile, as a function of commissioned years of service (CYOS) that can be used as a baseline for examination of the current and forecasted AAD inventories.

Suppose a group of officers accesses at $CYOS = 0$, and x percent are sent directly to graduate education institutions, and then enter the AAD inventory at $CYOS = 2$. The remaining $(1 - x)$ percent are assigned to an operations or staff assignment.

Next, suppose that, say 2/3, of officers on this initial assignment become eligible for reassignment after a 3-year tour ($CYOS = 3$). Of these, x percent, i.e., $[(2/3)(1-x)x]$ of the CYOS group, attend graduate education, thus entering the AAD inventory at $CYOS = 5$. The remaining officers, which comprise $\left[(2/3)(1-x)^2\right]$ percent of the year group, continue to a second operational or staff assignment.

Likewise, suppose the remaining 1/3 of officers on their initial assignment become eligible for reassignment at $CYOS = 4$. As before, x percent, i.e., $[(1/3)(1-x)x]$ of the CYOS group, attend graduate education, thus entering the AAD inventory at $CYOS = 6$. The remaining officers, who comprise $\left[(1/3)(1-x)^2\right]$ percent of the year group,

continue to a third operational or staff assignment. Note we could have alternatively specified officers becoming available at *CYOS* = 2, 3, and 4.

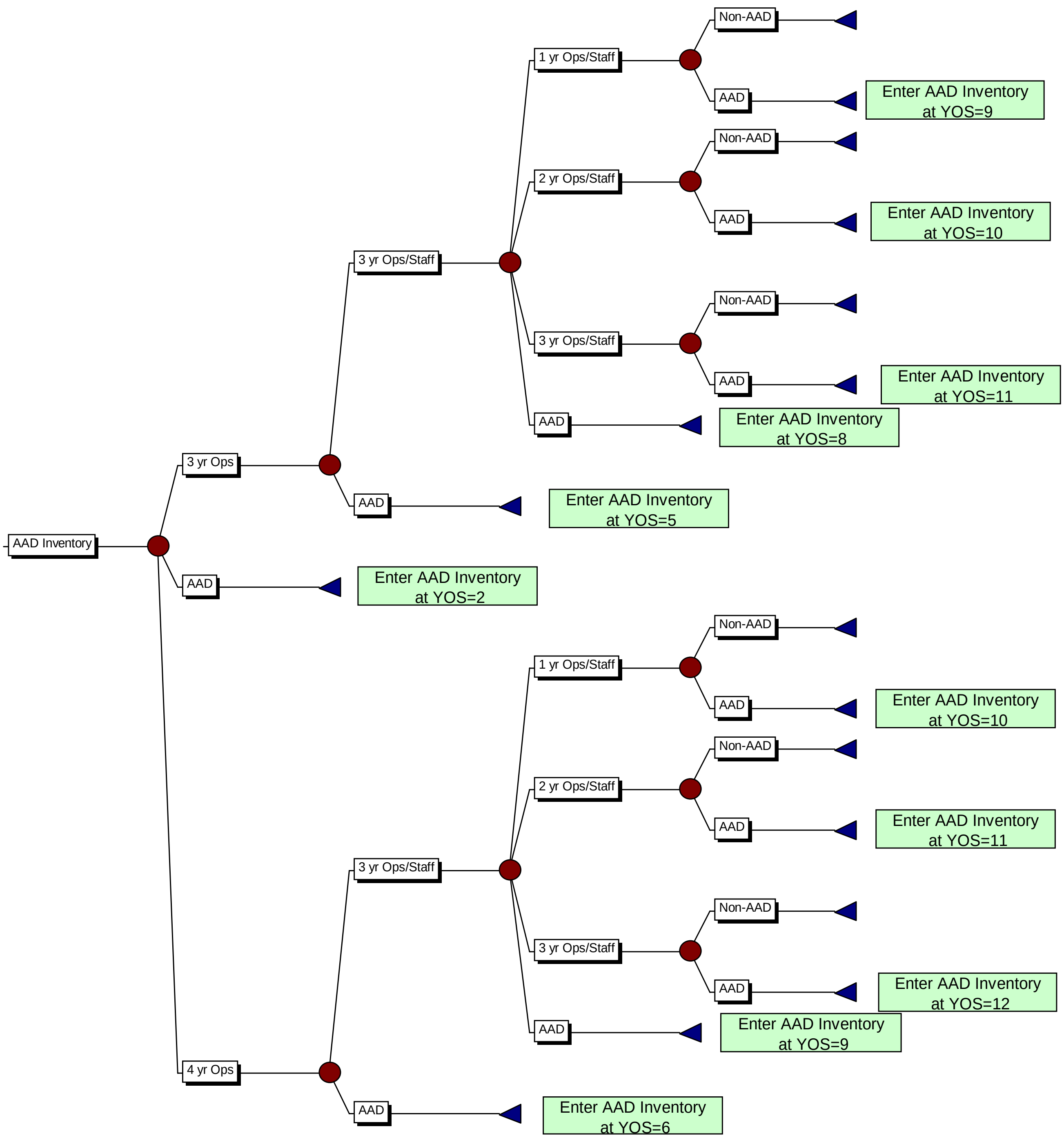

Figure 2: Tree Representation of a Notional Optimal Profile

Having completed the second operational assignment, x percent of this year group subset now attends graduate education. This yields $\left[(2/3)(1-x)^2 x\right]$ percent of the year group entering the AAD inventory at *CYOS* = 8, and $\left[(1/3)(1-x)^2 x\right]$ percent of the year group entering the AAD inventory at *CYOS* = 9.

Let us now define the Inventory Factor (IF) function as the percentage of a given year group's officers holding a career field related AAD as a function of CYOS. We have that

$$\text{IF}(CYOS = 9) = x + (1-x)x + (1-x)^2 x = x^3 - 3x^2 + 3x\,. \tag{24}$$

Now suppose that x percent of those officers completing three operational assignments are now selected for graduate education. For simplicity, and to account for accumulated variations in assignment timing, suppose that 1/3 of this subset group enters the AAD inventory, respectively, at *CYOS* = 10, *CYOS* = 11, and *CYOS* = 12. This yields a peak inventory factor at *CYOS* = 12, that is,

$$\text{IF}(CYOS = 12) = x + (1-x)x + (1-x)^2 x + (1-x)^3 x = -x^4 + 4x^3 - 6x^2 + 4x\,. \tag{25}$$

We define the aggregate inventory factor, $\overline{IF}$, as the weighted (by CYOS manpower relative to overall manpower) average inventory factor. That is,

$$\overline{IF} \quad = \quad \frac{\sum_{i=1}^{n} IF(CYOS = i)}{n}\,, \tag{26}$$

where n is the number of CYOS groups considered.

Data Requirements

The data needed to calculate the forecasts of the gains and losses to the AAD inventory was provided by the Air Force Personnel Center Analysis Section (AFPC/DPSAA). The data is a transactional snapshot of officers within the Space and Missile Operations (13S) and Scientists (61S) career fields who have received an AAD during the time period 01 Oct 93 to 30 Sep 04. Table 1 describes the fields available in the data file.

Table 2: Description of Date File Fields

Data Field	Description
ID_Number	Officer ID number
Year	Calendar year
CYOS	Total commissioned years of service
Grade	Highest grade during current year
Core_AFSC	Officer's primary Air Force specialty code (AFSC)
Duty_AFSC	Type of job occupied by an officer
AAD_Level	Level of education
Academic_Specialty	Type of degree of obtained

We are primarily interested in the Year, CYOS, Core_AFSC, AAD_Level, and Academic_Specialty fields in the data file. Data for CYOS and the fiscal years each officer was part of the AAD inventory are used to identify the number of AAD officers for every CYOS group for each year, respectively. The Core_AFSC field identifies which Development Team (DT) reviews the officer's record. AAD_Level and Academic_Specialty show the related graduate degree of each officer. From these data fields, we are able to construct a transition matrix for the forecasting model, which is discussed subsequently.

Our focus is on officers who obtain a master's degree that is relevant to their primary AFSC. There are 3050 degrees that may be reflected in the Academic Specialty field. Only a small subset of this list is "related" to the core career field job description.

MIL PDS uses a four character alpha numeric field to represent each degree obtained by an officer. Table 2 displays the recognized related master's degrees for the 13S and 61S career fields. Officers become part of an AAD inventory for the respective career field upon receiving one of these related master's degrees. They leave the AAD inventory upon separating, retiring, or transferring to another core AFSC. Note that it is possible for a career field to gain an AAD officer via transfer from another career field.

Table 3: Description of Related Master's Degrees for 13S and 61S Career Fields

Career Field	Academic_Specialty Code	Type of Degree
13S	0YRI	Space Operations - Information Operations
	0YRY	Space Operations
	4ISY	Space Systems
61S	0YEY	Operations Research
	0YSY	Operations Research – Strat and Tact

Data Initialization

Two tables are needed to calculate the transition rate matrix for the manpower forecasting model. The first table is called *New Entries* and calculates the total number of officers who enter the AAD inventory during each fiscal year. The second table, called *System Movement*, calculates, for each fiscal year, the total number of officers who move from the previous CYOS group to the next CYOS group in the AAD inventory. An officer will appear once in this table every year they are part of the AAD inventory and are not a new entry into the AAD inventory. Observe that an officer can only belong to one CYOS group in a given fiscal year.

To create the *New Entries* table, three new fields are created in the data file. The first field, Education Level, uses the AAD_Level field to determine the education level for each officer. If the AAD_Level = P, then the officer has received a master's degree

and has a MS designation in the Educational Level field, and if AAD_Level = R, then the officer has received a PhD and has a PhD designation in the Educational Level field. Otherwise, the officer has an "*XX*" in the Education Level field.

We noted that if an officer receives a subsequent degree, whether a master's degree or PhD from another institution or AFIT, then the AAD_level reflects only the latest degree received. However, once an officer receives a related degree from AFIT, the degree is never "lost." That is, if an officer receives a master's degree and then gets another master's degree, then they remain part of the AAD inventory; however, if they receive a PhD, they will leave the master's degree AAD inventory and move to the PhD AAD inventory. In other words, an officer can only be included, at most, in a single AAD inventory during a given fiscal year.

The second field, *Related Master's*, determines whether the degree obtained is related to the core AFSC the officer currently has listed during that fiscal year. The third field, *Related Master's Gain*, uses the two previous fields to determine the CYOS group for which each officer enters the AAD inventory. To create the second table, a fourth field is added to the data file called *Movement within the System*. An officer receives a "*Still In System*" flag during every fiscal year he remains in the AAD inventory.

Several data integrity issues arise in the data file. There are officers who have a blank core AFSC. The majority of such officers are those who enter active duty and are assigned to jobs in a particular career field but do not get "cored" until the second tour. This problem usually arises when the manning of junior officers is too high for a career field. In this case, the core AFSC is left blank until manning drops to prevent exceeding end strength restrictions. There are also cases where a cored officer will subsequently

lose the AFSC. These records are excluded from the data set. Finally, where there are data entry mistakes in MIL PDS, the respective records are excluded from the data set.

Historical manpower data broken out by CYOS is used to calculate the percentage of AAD officers in each CYOS group. The data for the total manning for the 13S and 61S career fields comes from the AFPC Report Builder webpage (22:1). This webpage allows a user to create custom Air Force historical personnel reports. The Report Builder has officer data from 1994 to 2004. Also, several fields such as CYOS and primary AFSC are available to build custom reports. For each fiscal year, a report was generated using CYOS and primary AFSC to create the Total Yearly Manning Table broken out by CYOS.

Transition Rates

Each year, officers move from the i^{th} CYOS group to the $(i+1)^{th}$ CYOS group. This can be represented graphically as shown below in Figure 3:

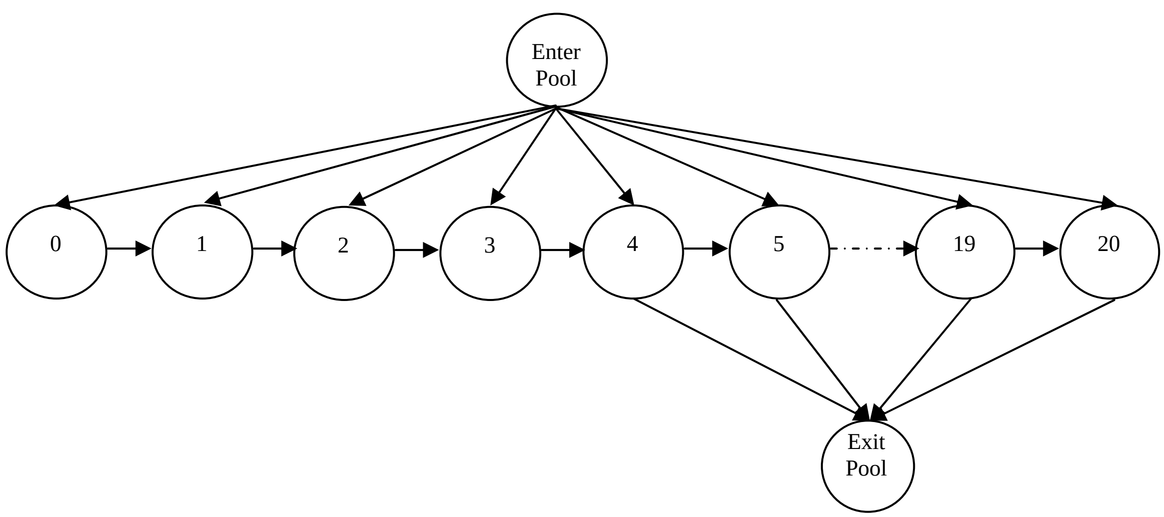

Figure 3: Diagram of Movement within the AAD Inventory

Officers enter the AAD inventory by obtaining an AAD. Observe that the AAD inventory is not limited to officers who obtain degrees from Air Force sponsored (funded) graduate programs. Therefore, it is possible for AAD officers to enter the AAD inventory prior to *CYOS* = 2, as seen in Figure 3, though this occurs infrequently. Such officers entering with *CYOS* = 0 will have an initial commissioning active duty service commitment (ADSC) of at least 4 years. Funded AAD graduates incur an ADSC of three years for master's degrees, but this ADSC runs concurrently with any other ADSC. Therefore, officers with *CYOS* = 0 who enter a funded AAD program will not exit the inventory until at least *CYOS* = 5. There are two paths once the ADSC is served: stay in the AAD inventory by retaining the same core AFSC or leave the AAD inventory by separating or changing career fields.

Now let us determine the rates at which AAD officers transition from *CYOS* = i to *CYOS* = (i+1) and exit the AAD inventory. We calculate these transition rates by adding together the elements from the New Entries and System Movement tables. We create a new table, called *Total Number of AAD Officers*, by adding new AAD officers to the AAD inventory with *CYOS* = i in year j and the current AAD officers in the AAD inventory with *CYOS* = i in year j.

The three tables, New Entries, System Movement, and Total Number of AAD Officers, can now be used to calculate the transition rates for AAD officers. To determine the number of officers who moved within the system to the next CYOS group, the total number of officers who remained in the system with *CYOS* = (i+1) in year (j+1) is subtracted from the total number of AAD officers with *CYOS* = i in year j. If the difference is 0, then no officers left the AAD inventory and the total number of AAD

officers from the Total Number of AAD Officers table is returned in the cell. If the difference is greater than 0, then the total number of AAD officers remaining in the system in year (j+1) is returned in the cell.

A matrix, called an *Activity Matrix*, is calculated for each fiscal year in the data file to capture the historical movement, attrition, and addition of AAD officers in the inventory from year j to year (j+1). Let $n_{i,(i+1)}$ be the total number of officers moving from $CYOS = i$ within the inventory to $CYOS = (i+1)$. Let $n_{i,exit}$ and $n_{enter,(i+1)}$ be the total number of officers that leave and enter the inventory from year j to year (j+1), respectively. A matrix is constructed as shown in Figure 4.

$$
\begin{bmatrix}
0 & n_{0,1} & 0 & 0 & 0 & 0 & \cdots & 0 & 0 & n_{0,exit} \\
0 & 0 & n_{1,2} & 0 & 0 & 0 & \cdots & 0 & 0 & n_{1,exit} \\
0 & 0 & 0 & n_{2,3} & 0 & 0 & \cdots & 0 & 0 & n_{2,exit} \\
0 & 0 & 0 & 0 & n_{3,4} & 0 & \cdots & 0 & 0 & n_{3,exit} \\
0 & 0 & 0 & 0 & 0 & n_{4,5} & \cdots & 0 & 0 & n_{4,exit} \\
\vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\
0 & 0 & 0 & 0 & 0 & 0 & \cdots & n_{18,19} & 0 & n_{18,exit} \\
0 & 0 & 0 & 0 & 0 & 0 & \cdots & 0 & n_{19,20} & n_{19,exit} \\
0 & 0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0 & n_{20,exit} \\
n_{enter,0} & n_{enter,1} & n_{enter,2} & n_{enter,3} & n_{enter,4} & n_{enter,5} & \cdots & n_{enter,19} & n_{enter,20} & 0
\end{bmatrix}
$$

Figure 4: AAD Activity Matrix for Year j to Year (j+1)

Rates for the movement within the AAD inventory and attrition are calculated by:

$$r_{i,(i+1)} = \frac{n_{i,(i+1)}}{n_{i,(i+1)} + n_{i,exit}} \text{ and } r_{i,exit} = \frac{n_{i,exit}}{n_{i,(i+1)} + n_{i,exit}}. \tag{27}$$

We let the rates for $r_{0,1}, r_{1,2}, r_{2,3}$, and $r_{3,4}$ equal 1 and $r_{0,exit}, r_{1,exit}, r_{2,exit}$, and $r_{3,exit}$ equal zero as per our previous discussion of ADSCs. Then, we average the activity matrix for every fiscal year in the data file together to get an average rate matrix. Then the average transition rate matrix, *T*, for AAD officers is expressed in Figure 5.

$$T = \left[\begin{array}{cccccccccc|c} 0 & 1 & 0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & \cdots & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & \cdots & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & \cdots & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \cdots & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \bar{r}_{5,6} & \cdots & 0 & 0 & \bar{r}_{5,exit} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \cdots & \bar{r}_{18,19} & 0 & \bar{r}_{18,exit} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \cdots & 0 & \bar{r}_{19,20} & \bar{r}_{19,exit} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0 & \bar{r}_{20,exit} \\ \hline 0 & 0 & r_{enter,2} & r_{enter,3} & r_{enter,4} & r_{enter,5} & r_{enter,6} & \cdots & r_{enter,19} & r_{enter,20} & 0 \end{array}\right]$$

Figure 5: Average Transition Rate Matrix

We define the row vector, $r_{enter,i}$, the entrance transition rate, as the rate officers with *CYOS* = *i* become part of the AAD inventory upon receiving a related master's degree. Determining the rate at which officers enter into the AAD inventory is a user input. The Air Force Education Review Board (AFERB) specifies quotas on Air Force sponsored graduate programs which can be used to determine the entrance transition rates into the AAD inventory. Note that military sponsored graduate (master's) education is eighteen months, but because of scheduling, two fiscal years elapse between starting and completing education. Therefore, we let the entrance transition rates, $r_{enter,0}$ and $r_{enter,1}$, equal zero, and $r_{enter,2}, \ldots, r_{enter,20}$ take a value between 0 and 1.

Forecasting Future Manpower Levels

To develop a forecast of future manpower levels for seven fiscal years, the Total Yearly Manning Table row sums are used as a time series. Recall from Chapter 2 that we can use Holt's linear exponential model to forecast the manpower. Holt's linear exponential model is automatically executed by computer programs, such as JMP, Minitab, or Crystalball, or is easily programmed in Excel. To find the best fit for the forecast using Excel, the Solver add-in can be used to vary the different levels of α and β that minimize Mean Square Error (MSE) between the actual and forecasted values.

Once the total manpower levels are forecasted, we then determine the average number of officers with $CYOS = i$, for each respective fiscal year. From the Total Yearly Manning Table, the historical data for each CYOS group is averaged to get an average percentage of the total manning for which $CYOS = i$. A new table is created that contains a row for each fiscal year's forecasted manpower levels with a column for each CYOS group. Finally, we multiply the forecasted manpower for each fiscal year by the average percentage of total manning for which $CYOS = i$ to determine the total average number of officers for which $CYOS = i$.

AADIM-E

The current AAD inventory, given by CYOS, becomes the initial starting row vector, s_0, for the forecast model. Also, since it takes at least two fiscal years for officers to obtain their master's degree, two classes of officers by CYOS group, who are attending or will attend graduate education called, c_1 and c_2, are required for the first two years of the forecast. Recall from Figure 5 that the average transition rate matrix, T, can be partitioned as

$$T = \left[\begin{array}{c:c} Q & w' \\ \hdashline p^i & 0 \end{array}\right] \tag{28}$$

where

w' = the attrition column vector

Q = the movement within the inventory matrix

p^j = the entrance transition rate row vector, $r_{enter,i}$, for forecasted year j

The initial AAD inventory, S_0, is multiplied by Q to calculate the number of officers who remain part of the AAD inventory for the following year. During the first two years of the forecast model, officers, who are already attending graduate education programs, will become part of the AAD inventory and are known values represented by C_i where i = 1, 2. Therefore, the first two years of the forecast are given by the equations

$$S_1 = S_0 Q + C_1 \text{ and} \tag{29}$$

$$S_2 = S_1 Q + C_2 . \tag{30}$$

Using Equations (29) and (30) and the forecasted manpower levels, we can then calculate the forecasted IF, as previously defined, for the next two years. This forecast may then be graphed against the idealized profile to show the current "health" of the AAD inventory and the projected health over the next two years for a given career field. Beginning with year 3 in the forecast, the projected impact of specified education policies to maintain, raise, or lower the AAD IF for each CYOS group can be compared with the idealized profile.

Recall we can use Equation (7) in Chapter 2 to forecast AAD inventories, but this works well only for specifying replacements for losses during each time period. That is, this formulation is used to maintain the current manning level. We can, however, modify

this formulation to include desired adjustments to manning levels, such as increasing the IF for chosen CYOS groups in a given career field.

To increase the IF for a chosen CYOS group, the number of AAD officers needs to be increased by sending officers who do not possess an AAD to graduate education programs. We can calculate the number of officers who do not possess an AAD for *CYOS* = (*i* + 1) in year (*j* + 1) by using the equation below:

$$d_{i+1,j+1} = h_{i+1,j+1} - \bar{r}_{i,i+1} s_{i,j} \text{ for } i = 0,\dots,20 \text{ and } j \geq 3 \tag{31}$$

where

$d_{i+1,j+1}$ = number of non-AAD officers with CYOS = (*i* + 1) in year (*j* + 1)

$h_{i+1,j+1}$ = average forecasted manpower for the (*i* + 1)th CYOS group in year (*j* + 1)

$\bar{r}_{i,i+1}$ = the transition rate of AAD officers from CYOS = *i* to CYOS = (*i* +1)

$s_{i,j}$ = number of AAD officers with *CYOS* = *i* in year *j*

Using the result from Equation (31), we can determine the future state of AAD inventory in year (*j* + 1) using the following equation:

$$s_{i+1,j+1} = \bar{r}_{i,i+1} s_{i,j} + r_{e,i+1} d_{i+1,j+1} \text{ for } i = 0,\dots,20 \text{ and } j \geq 3\,. \tag{32}$$

The first term, $r_{i,i+1} s_{i,j}$, determines the number of officers for each CYOS group who remain part of the AAD inventory. The second term, $r_{e,i+1} d_{i+1,j+1}$, calculates the number of officers selected for graduate education in year (*j* + 1) where $r_{e,i+1}$ is the entrance transition rate that specifies the desired percentage of non-AAD officers who need to

obtain an AAD to raise the IF. Note that $r_{e,i+1}$ is a user input and therefore independent of the average transition rate matrix, *T*.

Combining Equations (31) and (32), the forecast model can be stated as:

$$\begin{bmatrix} s_{0,j+1} \\ s_{2,j+1} \\ s_{3,j+1} \\ \vdots \\ s_{18,j+1} \\ s_{19,j+1} \\ s_{20,j+1} \end{bmatrix} = Q \begin{bmatrix} s_{0,j} \\ s_{2,j} \\ s_{3,j} \\ \vdots \\ s_{18,j} \\ s_{19,j} \\ s_{20,j} \end{bmatrix} + \begin{bmatrix} c_{0,j+1} \\ c_{2,j+1} \\ c_{3,j+1} \\ \vdots \\ c_{18,j+1} \\ c_{19,j+1} \\ c_{20,j+1} \end{bmatrix} \text{ for } j = 0, 1, \text{and } 2 \tag{33}$$

$$\begin{bmatrix} s_{0,j+1} \\ s_{2,j+1} \\ s_{3,j+1} \\ \vdots \\ s_{18,j+1} \\ s_{19,j+1} \\ s_{20,j+1} \end{bmatrix} = Q \begin{bmatrix} s_{0,j} \\ s_{2,j} \\ s_{3,j} \\ \vdots \\ s_{18,j} \\ s_{19,j} \\ s_{20,j} \end{bmatrix} + \begin{bmatrix} r_{e,1} \\ r_{e,2} \\ r_{e,3} \\ \vdots \\ r_{e,18} \\ r_{e,19} \\ r_{e,20} \end{bmatrix} \left(\begin{bmatrix} h_{0,j+1} \\ h_{2,j+1} \\ h_{3,j+1} \\ \vdots \\ h_{18,j+1} \\ h_{19,j+1} \\ h_{20,j+1} \end{bmatrix} - Q \begin{bmatrix} s_{0,j} \\ s_{2,j} \\ s_{3,j} \\ \vdots \\ s_{18,j} \\ s_{19,j} \\ s_{20,j} \end{bmatrix} \right) \text{ for } j \geq 3. \tag{34}$$

AADIM-U

The objective of the Advanced Academic Inventory Model – Utilization (AADIM-U) is to determine an optimal assignment matching for AAD officers available to permanently change station (PCS) to vacant AAD billets. Each officer has a set of characteristics (e.g., rank, security clearance, AFSC, etc.), that qualifies them for one or more assignments. We can compare these characteristics to each billet's requirements to examine whether or not an officer qualifies to be assigned.

We modify the assignment problem formulation as defined in Chapter 2 to be the following:

$$\text{maximize} \quad \sum_{i}^{m}\sum_{j}^{n} p_j a_{ij} x_{ij} \tag{35}$$

$$\text{subject to} \quad \sum_{j}^{n} x_{ij} \leq 1 \; \forall \, i \tag{36}$$

$$\sum_{i}^{m} x_{ij} \leq 1 \; \forall \, j \tag{37}$$

$$x_{ij} = \begin{cases} 1 & \text{if officer } i \text{ is assigned to assignment } j \\ 0 & \text{otherwise} \end{cases} \tag{38}$$

where a_{ij} is the level of qualification of officer i with respect to assignment j and p_j is the relative assignment priority ascribed to assignment j. AAD officers may be qualified for one or more assignments during any assignment cycle, but each AAD officer is not equally qualified for every assignment. Hence, we assign each AAD officer a qualification score between 0 and 1 for each assignment that an officer is qualified for in the assignment matrix, A. We let $a_{ij} = 0$ indicate when an officer is not qualified to be matched to an assignment, while $a_{ij} = 1$ indicates that an officer meets every requirement for the assignment. This allows a decision maker to rank order preferences between AAD officers with respect to a given assignment according to their qualifications.

Note that every billet is assigned a priority ranking to indicate the relative importance of each billet during the current assignment cycle. The priority ranking score ranges from 0 to 1 where 1 is the highest priority. We can use an interview process such as described in Chapter 2 to determine the priorities for each assignment. For the present research, we shall assume that all assignments have equal weighting, that is, $p_j = 1$ for all j.

Data Requirements

The necessary officer and assignment data needed to execute the utilization model can be collected from Air Force Personnel Center (AFPC), via MIL PDS and ODP. To demonstrate the model's use, we utilize a notional data set. Table 4 gives a list of typical data requirements for each type data used in this model.

Table 4: Type and Description of Data Required for AADIM-U

	Data Field	**Description**
Officer Data	O_Rank	Rank of officer
	O_Type of AAD	Type of degree of obtained
	O_SC	Security Clearance of officer
	O_Experience_Lvl	Officer's level of experience
	O_Training_Lvl	Officer's level of training
	DT Vector	Type of DT vector assigned to an officer
	Location Pref	Location preferences of the officer
Assignment Data	A_Rank	Rank requirement of billet
	A_AAD Type	Type of AAD preferred
	A_SC	Type of Security Clearance required
	Duty Type	Type of DT vector assigned to an officer

Creating the Qualification Matrix

We can now use the data fields to develop the qualification matrix, *A*. This matrix is designed to be flexible to the needs of each career field and each assignment cycle. Depending on the particular career field, data fields can be added or removed from consideration as necessary.

Generally speaking, assignment requirements vary from one career field to another, but generally, assignment qualifications are partitioned into one of two categories: "required" and "desired." A required qualification is one such that the officer must possess to be eligible for the assignment. The desirable qualifications are a set of job characteristics that determines a "goodness of fit" between an assignment and a potential officer. An assignment match may occur, however, with an officer that does not

possess some or all of these characteristics. For example, a commander desires to have an analyst who is familiar with simulation but would accept an analyst without this specific expertise.

The following example illustrates the use of required and desired qualifications to determine the qualification score a_{ij}. Suppose, for some job j, the position requires the incumbent to be either in the grade of O-3 or O-4. The respective commander desires an O-4 officer, but will accept an O-3 officer, that is, O-4 is a desired qualification. Let us partition the set of officers, denoted as I for this example, that are available for reassignment, as $I = \{i1, i2, i3, i4, i5\}$, where the numeral 1, 2,…, 5 denotes the officer's respective pay grade. Therefore, we have that $a_{i1j} = a_{i2j} = a_{i5j} = 0$, since these officers do not meet the required grade qualification. Further, we have that $a_{i3j} > 0$ and $a_{i4j} > 0$, since these officers meet the required qualification, and also that $a_{i4j} > a_{i3j}$, since O-4 officers additionally meet the desired qualification. That is, an O-4 officer is preferred to an O-3 officer for assignment j.

Observe that required qualifications serve as an effective "pre-screening" of candidates by setting $a_{ij} = 0$ for any officer that does not meet any subset of the required qualifications. Taking a standardized categorization of desired qualifications, we develop a multi-attribute value function that can be used to obtain a qualification score $a_{ij} \in [0,1]$ to complete the overall qualification matrix, A.

Let us define seven attributes to be used to determine a qualification score for any given assignment, as listed in Table 5 below.

Table 5: Qualification Attributes

Attribute	Description
1	Grade
2	Academic Specialty Code
3	Security Clearance
4	Experience
5	Training
6	DT Vector
7	Officer Preferences (OPD)

Assuming preferential independence holds between the attributes, as described in Chapter 2, we can use an additive functional form, that is,

$$V\left\{x^1, x^2, ..., x^7\right\} = \sum_{a=1}^{7} k^a v^a(x^a), \tag{39}$$

where k^a and $v^a(x^a)$ are the individual weighting constant and the uni-variate value function, respectively, for each attribute. Examining the seven attributes in Table 5, it is intuitive that preferential independence should hold, and we shall leave for future research a formal verification of this property. Each entry in the qualification matrix, A, is therefore determined by

$$a_{ij} = V\left\{x_{ij}^1, x_{ij}^2, ..., x_{ij}^7\right\} = \sum_{a=1}^{7} k^a v^a(x_{ij}^a), \quad \forall (i, j). \tag{40}$$

The present research seeks to demonstrate the efficacy of using a value function to generate qualification scores for officers with respect to potential assignments. As such, we shall use simplified uni-variate value functions that express a binary preference structure. We let $v^a(x^a) = 1$ if the desired qualification is met, and $v^a(x^a) = 0$ if the

desired qualification is not met. We leave refinements to this approach for future research. Table 6 below describes the individual value functions in more detail.

Table 6: AADIM-U Individual Value Function Descriptions

Grade	$v^1(x^1) = 1$	Officer in grade requested
	$v^1(x^1) = 0$	Officer not in grade requested
Academic Specialty Code	$v^2(x^2) = 1$	Officer possesses code requested
	$v^2(x^2) = 0$	Officer possesses related code only
Security Clearance	$v^3(x^3) = 1$	Officer possesses clearance requested
	$v^3(x^3) = 0$	Officer does not possess clearance requested
Experience	$v^4(x^4) = 1$	Officer possesses all experience requested
	$v^4(x^4) = 0$	Officer does not possess some or all experience requested
Training	$v^5(x^5) = 1$	Officer possesses all training requested
	$v^5(x^5) = 0$	Officer does not possess some or all experience requested
DT Vector	$v^6(x^6) = 1$	Assignment is of type/category recommended by DT
	$v^6(x^6) = 0$	Assignment is not of type/category recommended by DT
Officer Preferences	$v^7(x^7) = 1$	Assignment type/location appears on OPD
	$v^7(x^7) = 0$	Assignment type/location does not appear on OPD

To determine the weighting constants, k^a, we use the swing weight methodology described in Chapter 2. The DM is first asked to order the attributes by importance, from highest to lowest, and re-index the attributes in ascending numerical order (note that the indexes given in Table 6 are arbitrary). To complete the swing method for seven attributes, the following process must be performed six times. For experiment a, a = 1,2,…,6, the DM is presented with two theoretical assignment alternatives, A and B, such that for alternative A, the a^{th} attribute is set at its most preferred level, while the remaining attributes are set at their respectively least preferred levels; for alternative B,

the $(a+1)^{th}$ attribute is set at its most preferred level, while the remaining attributes are set at their respectively least preferred levels. The DM is then asked to ascribe a relative value, r_a, between these two alternatives, i.e.,

$$\frac{V(A)}{V(B)} = r_a \,. \tag{41}$$

Recall from Chapter 2 that the ratio, r_a, given in Equation (41) is the relative weighting between the a^{th} and $(a+1)^{th}$ attributes, that is, $k^a \big/ k^{a+1} = r_a$. Once this series of experiments is complete, we can solve the following system of linear equations to determine the weighting factors for the multi-attribute value function used in Equations (15) and (16):

$$k^a - r_a k^{a+1} = 0 \quad a = 1, 2, \ldots, 6 \tag{42}$$

$$\sum_{a=1}^{7} k^a = 1 \,. \tag{43}$$

Recall that Equation (43) results from the assumption of preferential independence of the attributes that yields an additive value function.

To ensure the DM has expressed a consistent preference structure, we calculate the ratio of weights between two arbitrary attributes a and b, such that $a \neq b$ and $b \neq a+1$, and ask the DM whether he/she agrees with this relative weighting. If the DM does not agree, we must revisit the ratios expressed in the previous iterations of Equation (41), as the DM has indicated an inconsistent preference structure. If the DM agrees, we repeat the foregoing question with unique attribute pairs until we are satisfied that we have obtained a consistent preference structure. Note that a rigorous examination of

preferential consistency would require ${}_7\mathbf{C}_2$=21 pairwise ratio comparisons, but that such examination is rarely necessary in practice.

Solving the Assignment Problem

We can solve the assignment problem described in Equations (35) – (38) after the qualification matrix, *A*, is evaluated. Several computer programs, such as Matlab, LINDO, Microsoft Excel, and SAS, have the capabilities to solve linear programs. Even though the qualification matrix has been created in Microsoft Excel, SAS is a better choice to solve the assignment problem since it has a built-in function to solve assignment problems and AFPC has several SAS licenses.

In this chapter, we outlined the AADIM-E by first describing how to generate a notional career field idealized education profile, and then developing the Markov model used to forecast graduate education requirements. For the AADIM-U, we formulated an integer programming assignment problem to find the optimal matching between AAD officers and AAD assignments, maximizing an objective consisting of qualification scores obtained via a multi-attribute additive value function. In Chapter 4, we will discuss the results obtained by using notional data for 61S and 13S career field officers and assignments to demonstrate the capabilities of each of the sub-models.

IV. Results

AADIM-E

The validation of the AADIM-E is performed using the historical data on the Space and Missile Operations (13S) and Scientists (61S) career fields collected from the Air Force Personnel Center Analysis Section (AFPC/DPSAA) and AFPC IDEAS website (24:1). The historical data is for the ten year period 01 Oct 94 to 30 Sep 04.

The transactional data from AFPC/DPSAA is used to construct the tables described in Chapter 3 to calculate the transaction rates for the CYOS groups in each fiscal year (FY). Likewise, we use the AFPC IDEAS website to collect the total manpower data, disaggregated by CYOS for FY94 to FY04 (24:1). We partition the data into an initialization set and a test set. The initialization set ranges from FY94 to FY02 and is used to develop average transition rates for officers who move from the i^{th} CYOS group to $(i+1)^{th}$ CYOS group. The total manpower data from FY94 to FY02 is used to forecast the total manpower levels for FY03 to FY09 using the Holt linear exponential smoothing model. The test set, FY03 and FY04, is used to demonstrate the ability of the model to forecast accurate results. Refer to Appendix A and B for the complete set of data used to develop forecast educational requirements and Appendix C and D for the entire results for the 61S and 13S career fields, respectively.

Forecasting Manpower

We use the AFPC IDEAS website to collect actual manpower levels for officers with CYOS = 0, 1, . . ., 11, and use this data to forecast future manpower levels (27:1). Figures 6 and 7 show the forecasted and actual total manpower levels for the 61S and 13S career fields, respectively, using the Holt linear exponential smoothing model.

Recall from Chapter 2 that using historical data to develop forecasted manpower levels implies that such forecasts will be dictated by past policies. This effect is seen in Figures 6 and 7. The trend in the actual manpower levels from FY97 to FY02 for the 61S career field is a decreasing trend. This trend is reflected in the forecasted manpower levels which decrease over the forecasted time period. Note the similar effect for the 13S career field. The actual manpower levels rise drastically from FY94 to FY95. The forecast predicts that the manpower increases in FY96 but the actual manpower decreases in FY96 and continues to decrease through FY02. The forecasted values reflect the general decreasing trend.

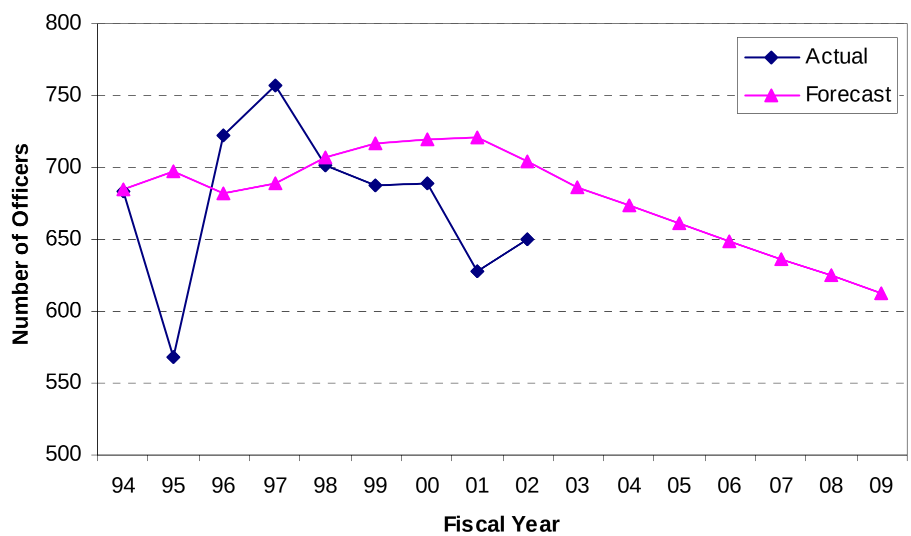

Figure 6: Forecasted vs. Actual Manpower Levels for 61S Career Field

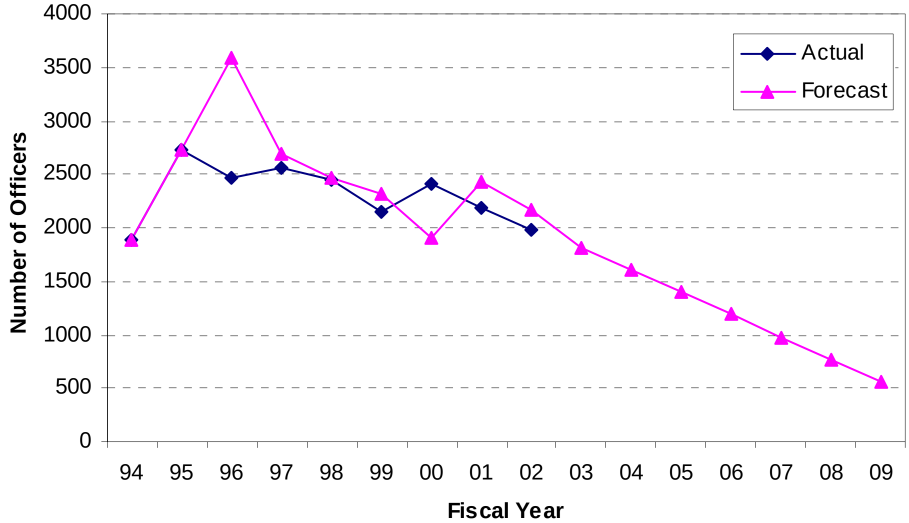

Figure 7: Forecasted vs. Actual Manpower Levels for 13S Career Field

It is also seen that there are differences between the two career fields. Both career fields forecasted manpower levels decrease but the 61S manpower decreases by a smaller number of officers between FY94 and FY02. The 13S manpower levels fluctuate more starting at a manpower high of 2736 in FY95 and decreasing to low of 1986 in FY02. This trend is reflected in the forecasted values, which decrease by nearly 210 officers per year. This is a drastic difference from the 61S career field forecasted manpower levels, which only decrease by 12 officers per year.

Forecasting Education Requirements: 61S Career Field

The development of educational requirements is separated into two sections. In the first section, the idealized graduate education profile is specified and used to gauge the "health" of a career field for each year in the forecast. In addition, the first two years of the forecast are calculated using the average transition rate matrix for the 61S career field, plus officers who previously were selected to attend an Air Force sponsored graduate education program. The second section forecasts the educational requirements

needed to increase number of AAD officers to meet the aggregated idealized educational profile.

The FY02 aggregate AAD inventory percentage is 10.6%. For the validation of the model, we want to increase the aggregate AAD inventory percentage to 30.0%. Then to increase aggregate AAD inventory percentage, we let $\overline{IF}$ be 30.0%.

Table 7: Notional Idealized Education Profile Inputs for 61S

	Percentage
Officers Selected to Attend Graduate Education	20.4%
Officers with Initial 3 Year Assignment	50.0%
Officers released from their Initial Assignment at 2 CYOS	0%

Three user inputs described in Table 7 are used to develop a disaggregate idealized education profile by CYOS for $\overline{IF}$. We then graph the disaggregate idealized education profile percentage along with the current AAD inventory by CYOS to obtain a snapshot of the current "health" of the AAD inventory. The percentages in Table 7 are selected for each of the user inputs to obtain $\overline{IF}$ which we use to graph the current inventory and the notional idealized education profile together. The shortages and surpluses are then calculated as displayed in Figure 8.

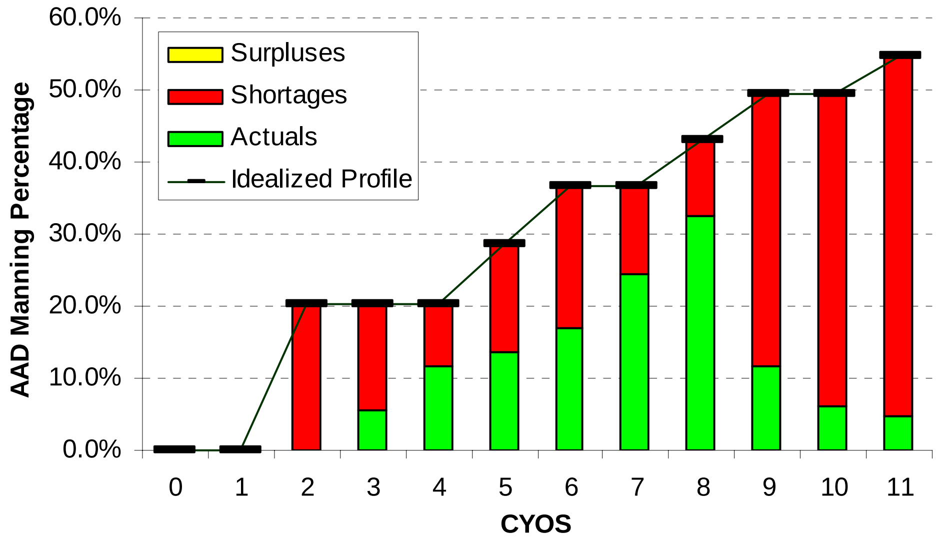

Figure 8: 61S AAD Inventory for fiscal year 2003 and Notional Idealized Profile

Recall that the first two fiscal years in our forecast, FY03 and FY04, are calculated using the average transition rate matrix plus officers who were previously selected to attend an Air Force sponsored graduate education program. Note that FY03 and FY04 are the test set, where the actual AAD inventory for each year is known. Figures 9 and 10 compare the forecasted results to the actual AAD inventory.

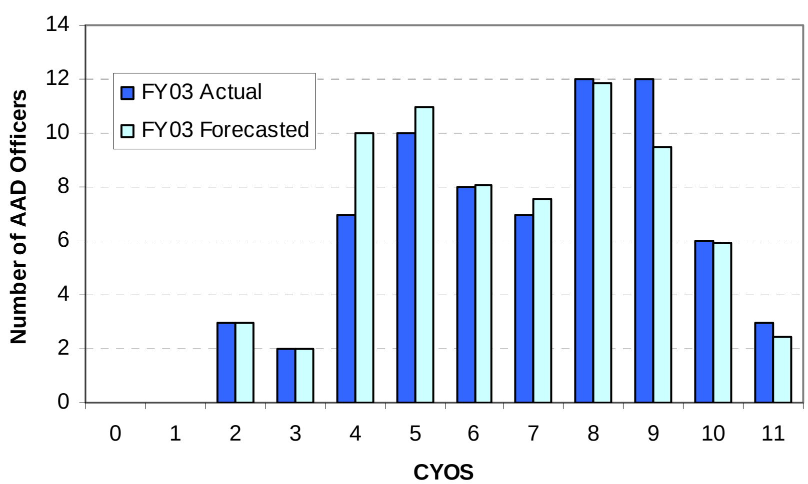

Figure 9: FY03 Predicted and Actual AAD Inventory for 61S Career Field

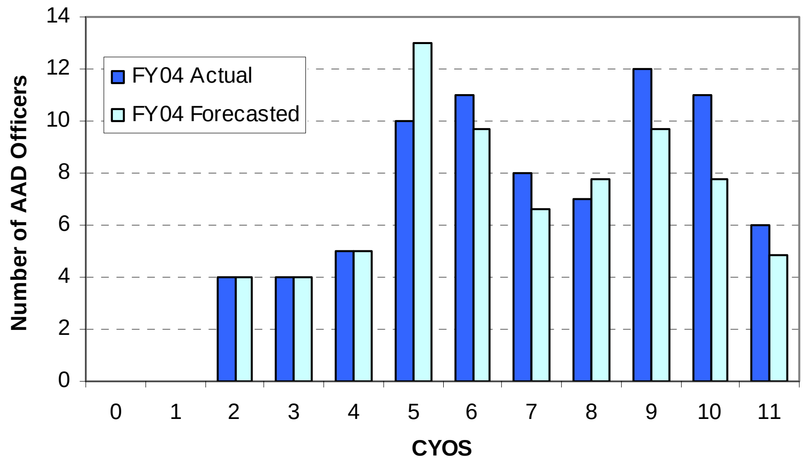

Figure 10: FY04 Predicted and Actual AAD Inventory for 61S Career Field

The aggregate forecasted AAD inventory percentages for FY03 and FY04 are 11.2% and 11.6%, respectively, and the aggregate actual AAD inventory percentages for FY03 and FY04 are 11.7% and 12.4%, respectively. The differences between the forecasted and actual are 0.05% and 0.08%. As expected, the first year of the forecast is more accurate than the second year.

The second phase of the AADIM-E forecasts the educational requirements necessary to increase or maintain the aggregate AAD inventory percentage for a career field to match $\overline{IF}$. Recall that we use the average transition rate matrix to determine the number of officers who move from the i^{th} CYOS group to $(i+1)^{th}$ CYOS group. We then determine the number of officers who need to be sent to a graduate education program to obtain an AAD using an entrance transition rate. Note that the entrance transition rate specifies a desired percentage of non-AAD officers who need to obtain an AAD to increase the aggregate AAD inventory.

To help the user determine the best course of action to increase the aggregate AAD inventory percentage to approach $\overline{IF}$, four options (4-year, 5-year, 6-year, and 7-year options) are presented to the user that determine the entrance transition rate for each CYOS group to raise the "health" of the AAD inventory. Refer to Appendix E for the code used to program each option.

Figure 11 shows that each plan of action reaches $\overline{IF}$ at different fiscal years as expected. The aggregate forecasted AAD inventory percentages for each plan reaches $\overline{IF}$ in the proper fiscal year as expected except the 4-year plan. We see the 4-year plan increases sharply to $\overline{IF}$ in the 4th year in the forecast, but it does not reach $\overline{IF}$ until the 5th year. Recall that officers initially attend a two-year graduate education program or are assigned to a 3 or 4 year assignment. It is not feasible to satisfy $\overline{IF}$ with this configuration because officers with 3 or 4 CYOS are not able to finish a graduate education program in this shortened time period and enter into the AAD inventory.

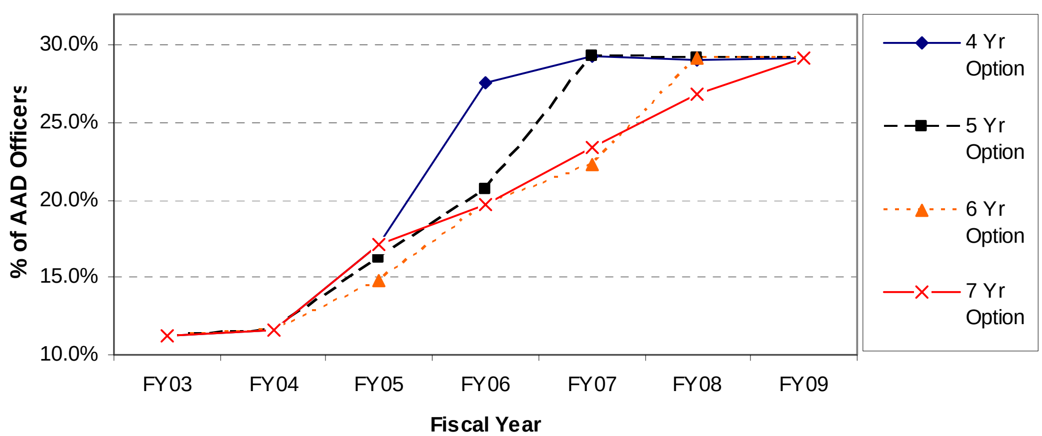

Figure 11: Aggregate AAD Inventory Percentage for 61S Career Field (Notional)

Figure 12 graphs the educational requirements produced for the 61S career field by each option for every fiscal year. We see a large spike in number of officers in FY06, the 4th year in the forecast, in the 4-year option but then the educational quotas for the following three years drop off sharply. A similar effect is seen in the 5-year and 6-year option, but for each option, the spikes occur in subsequent years and are less pronounced. The 7-year option lacks any large spikes. The educational requirements are distributed more evenly throughout the forecast than for the previous options.

The options demonstrate four approaches used to raise the aggregate AAD inventory percentage. The first three options show that surges in officer education are needed to meet $\overline{IF}$. To handle these surges, graduate education programs would have to hire more short-term staff which might not be feasible or practical. Therefore, it would be more advantageous to avoid large variations in graduate education student loads by adopting a longer-term approach to reach $\overline{IF}$, such as shown in the 7-year option.

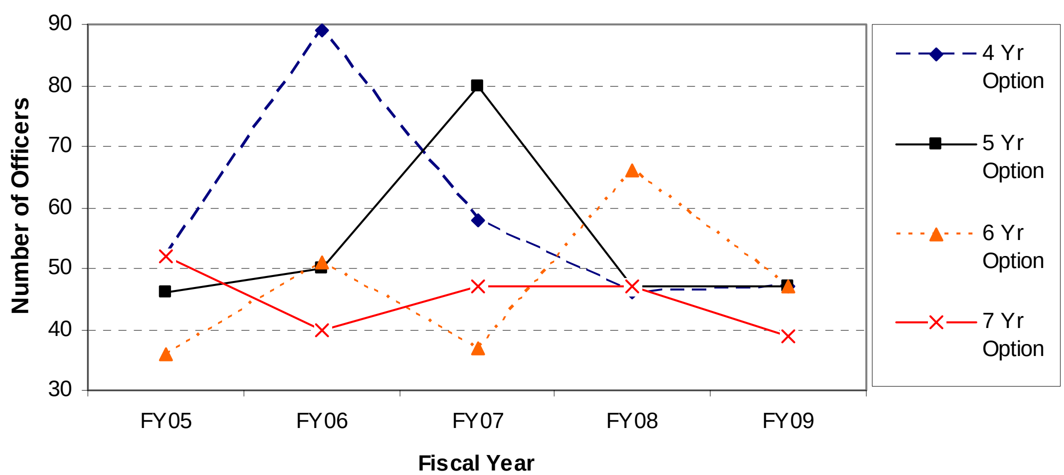

Figure 12: Total Yearly Educational Requirements for 61S Career Field (Notional)
Forecasting Education Requirements: 13S Career Field

For the 13S career field, we apply the same methodology previously discussed to forecast graduate education requirements. The first step is to specify $\overline{IF}$ for the career field. The 13S aggregate AAD inventory percentage is 1.7% for FY02, which is only 39 AAD officers out of 650 officers with less than 12 CYOS. For the purpose of this example, it is desired to increase the aggregate AAD inventory percentage to 10.0%. Table 8 shows the percentages that are used to create the idealized education profile.

Table 8: Notional Idealized Education Profile Inputs for 13S

	Percentage
Officers Selected to Attend Graduate Education	6.0%
Officers with Initial 3 Year Assignment	66.7%
Officers released from their Initial Assignment at 2 CYOS	0%

The forecasted and actual AAD inventories for FY03 and FY04 are plotted in Figures 13 and 14, respectively. The actual AAD inventory profile percentages for FY03 and FY04 are 1.7% and 2.0%. The aggregated forecasted AAD inventory percentage for FY03 is 2.1% and 2.5% for FY04. For the 13S career field, the differences between the forecasted and actual aggregated AAD inventory percentages for FY03 and FY04 are 0.4% and 0.5%, respectively.

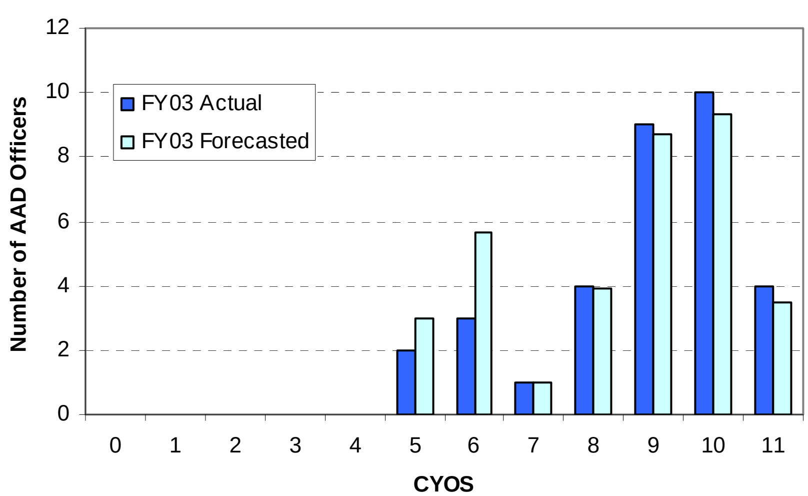

Figure 13: FY03 Predicted and Actual AAD Inventory for 13S Career Field

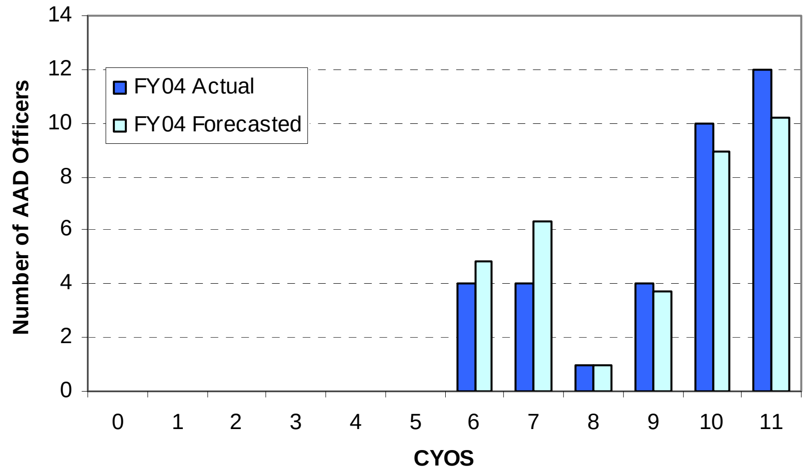

Figure 14: FY04 Predicted and Actual AAD Inventory for 13S Career Field

We use the same four options as in the previous section to forecast the educational requirements for the next five years. Figure 15 shows the aggregated forecasted AAD inventory percentage for each option. We expect for each option that the forecasted aggregate AAD inventory percentage to reach the 10% $\overline{IF}$ and then maintain that level for the subsequent fiscal years in the forecast. Instead, each option $\overline{IF}$ and continues to increase.

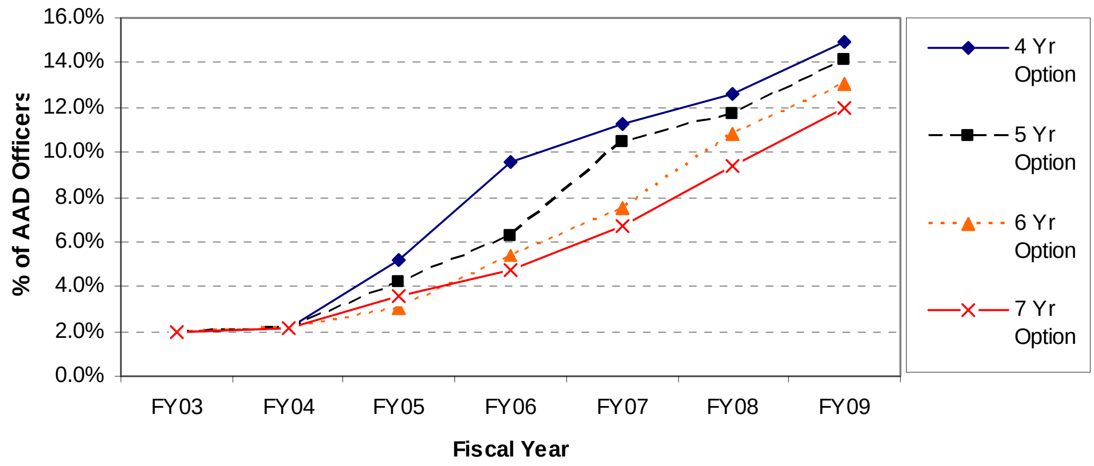

Figure 15: Aggregate AAD Inventory Percentage for 13S Career Field (Notional)

To understand this phenomenon, recall the previous discussion about the forecasted manpower levels for each career field. The 13S career field forecasted manpower levels decrease by approximately 210 officers each fiscal year. For each option, we increase the aggregate AAD inventory percentage every year until $\overline{IF}$ is met, and then in the subsequent fiscal years, we maintain $\overline{IF}$. Based on the average transition rate matrix for the 13S career field, the majority of new AAD officers remain in the AAD inventory. These two factors combine to cause the forecasted aggregate AAD inventory percentage to continue to increase in the subsequent fiscal years. Note that the earlier the aggregate forecasted AAD inventory percentage is forced to the idealized, the higher the aggregate forecasted AAD inventory percentage in the 7th fiscal year is.

Figure 16 shows the educational requirements produced by the four different options for the 13S career field data. We see that for all options the educational requirements are converging toward zero. This effect is consistent with the previous discussion of the increasing aggregate AAD inventory percentages. Once $\overline{IF}$ is reached

in the 4-year and 5-year option, the educational requirements drop off drastically, but the 6-year and 7-year option spread the educational requirements out more amongst the fiscal years. Note that forecasted decline in the projected 13S manpower, based on previous population as shown in Figure 7, yields education requirements approaching zero in the out-years, despite a significant increase in the AAD IF to 10%. It is clear that alternative future manpower estimates must be examined to obtain more satisfactory education quota estimates.

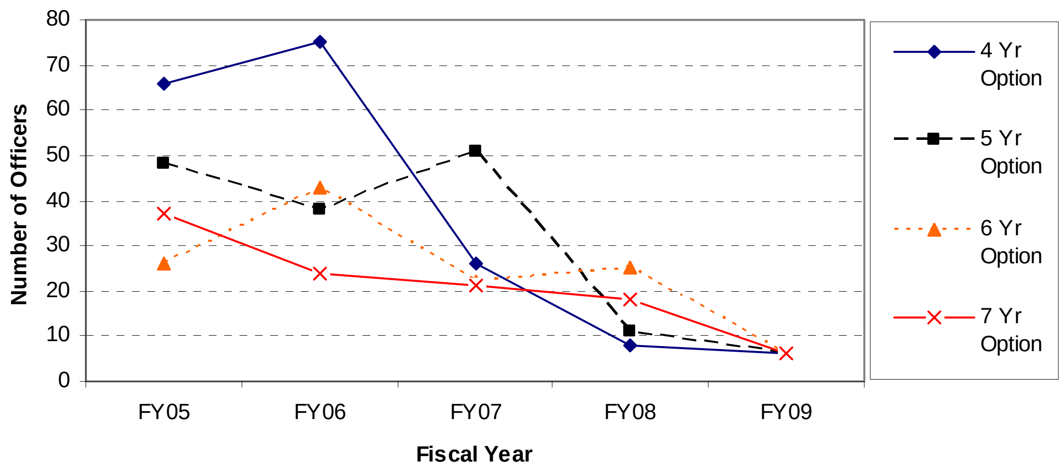

Figure 16: Total Yearly Educational Requirements for 13S Career Field (Notional)

We consider two additional scenarios using the 13S career field data. In the first scenario, we assume that the total manpower increases by 10% each fiscal year. Repeating the foregoing analysis, Figure 17 shows the aggregate AAD inventory percentages for each option. Note that Figure 17 looks very similar to the 61S career field aggregate AAD inventory percentages shown in Figure 11, but as the forecasted total manpower increases, the aggregate AAD inventory percentages remain slightly below $\overline{IF}$.

It is interesting to note that we expected to see the education requirements distributed more evenly for the 6-year and 7-year options like the 61S career field. However, the results prompt consideration that each career field has unique AAD inventory characteristics and assignment paths.

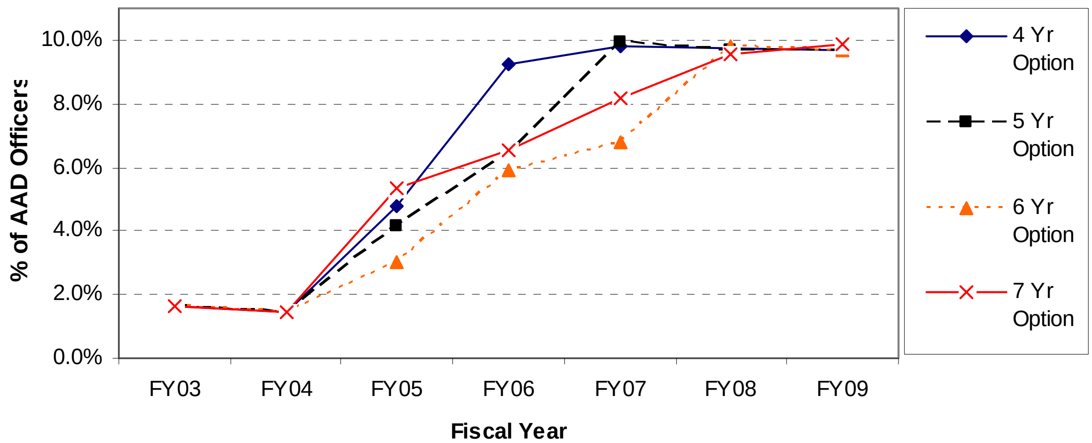

Figure 17: Aggregate AAD Inventory Percentage for 13S Career Field with Increasing Manpower

Figure 18 shows the yearly graduate education requirements for the 13S career field with increasing manpower. As before, there is a large spike in the number of officers requiring education in FY06 for the 4-year option but then educational quotas for the following three years drop off sharply. A similar effect is seen in the 5-year option, but the spike occurs in FY07, the 5th forecasted year, and is less pronounced. The 6-year option has two spikes in FY06 and FY08, and the 7-year option has a large spike in FY05.

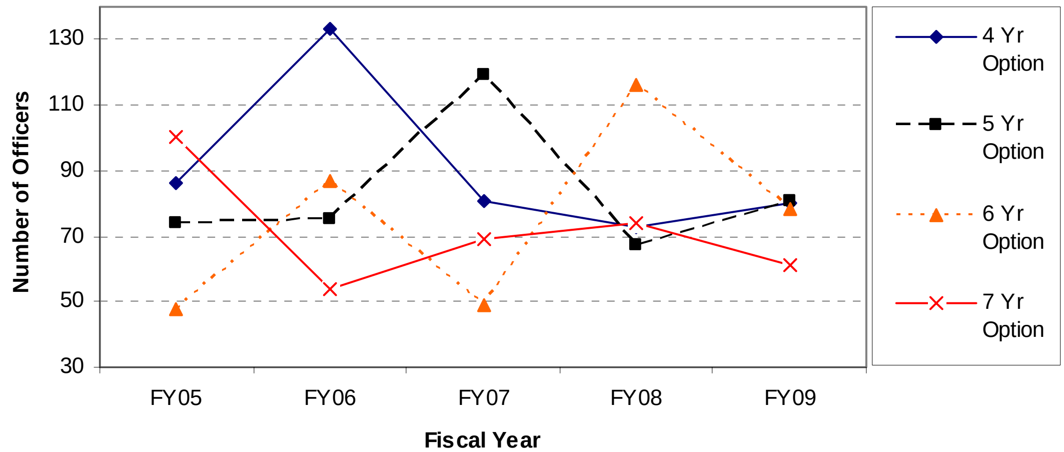

Figure 18: Total Yearly Educational Requirements for 13S Career Field with Increasing Manpower

For the second scenario, we consider the case where the total manpower levels for the 13S career field remain constant over the forecasted time period. Figure 19 shows the yearly aggregate AAD inventory percentages for each option. For each option, the aggregate AAD inventory percentage increases to $\overline{IF}$ and remain at this level for subsequent fiscal years.

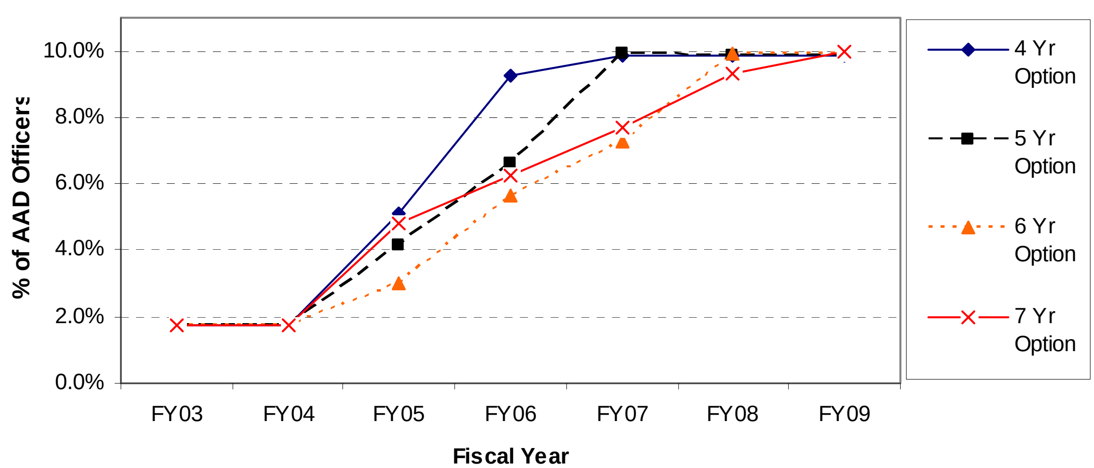

Figure 19: Aggregate AAD Inventory Percentage for 13S Career Field with Constant Manpower

Figure 20 shows the yearly graduate education requirements for the 13S career field with constant manpower. We see similar results to the constant manpower education requirements for the 13S career field, but in later fiscal years, the graduate education requirements are higher.

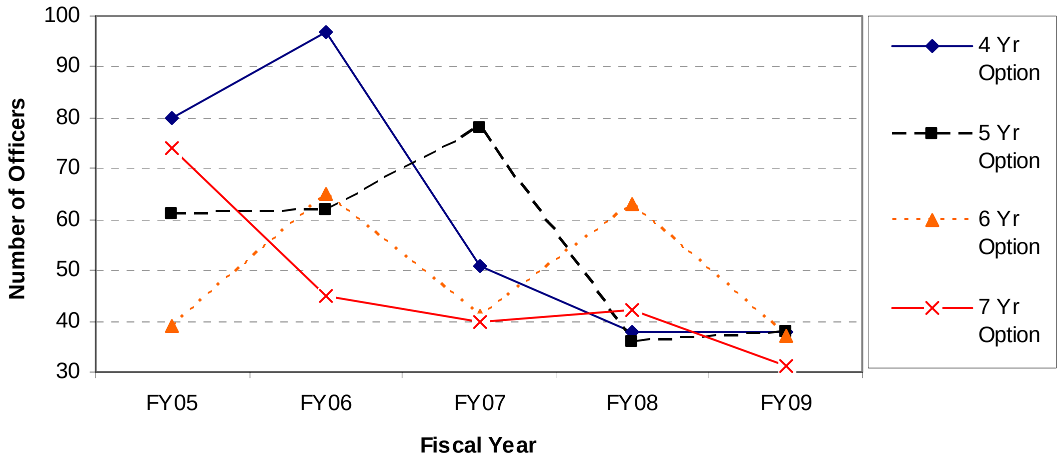

Figure 20: Total Yearly Educational Requirements for 13S Career Field with Constant Manpower

Figures 21 and 22 show the aggregate AAD inventory percentage and educational requirements, respectively, for three additional options (8-year, 9-year, and 10-year options) for the 13S career field with constant manpower. Figure 21 shows that as the number of years in the forecast increase, the curve becomes smoother. In addition, both the 9-year and 10-year options reach $\overline{IF}$ in year 9 of the forecast suggesting that both options yield similar educational requirements.

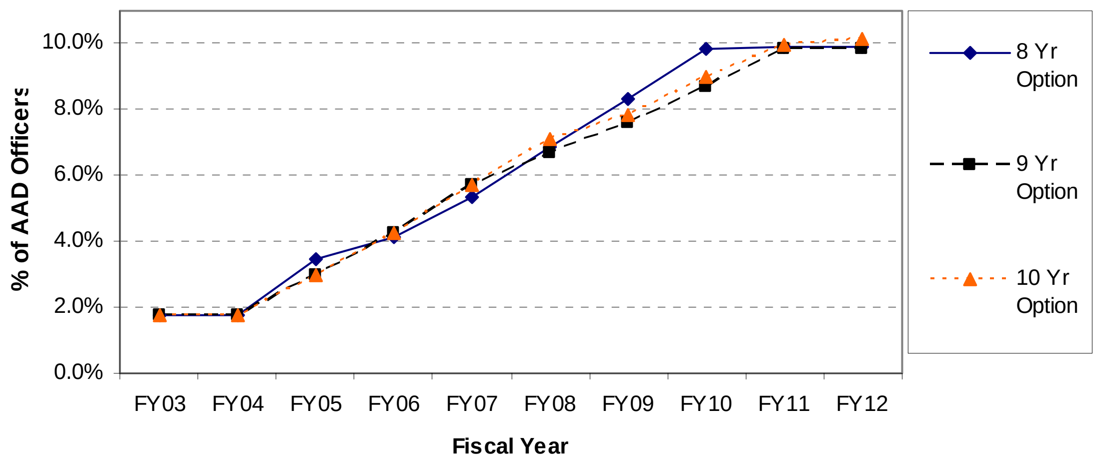

Figure 21: Aggregate AAD Inventory Percentage for 13S Career Field with Constant Manpower

The educational requirements in Figure 22 become more evenly distributed as the length of time allowed to meet $\overline{IF}$ increases. The 8-year option has small spikes in the 1st and 8th fiscal years of the forecast, but the 9-year and 10-year options lack any large increases in educational requirements. Hence, it can be anticipated that it will take nearly a decade to gradually increase the aggregate educational profile of any career field without inducing educational requirement surges.

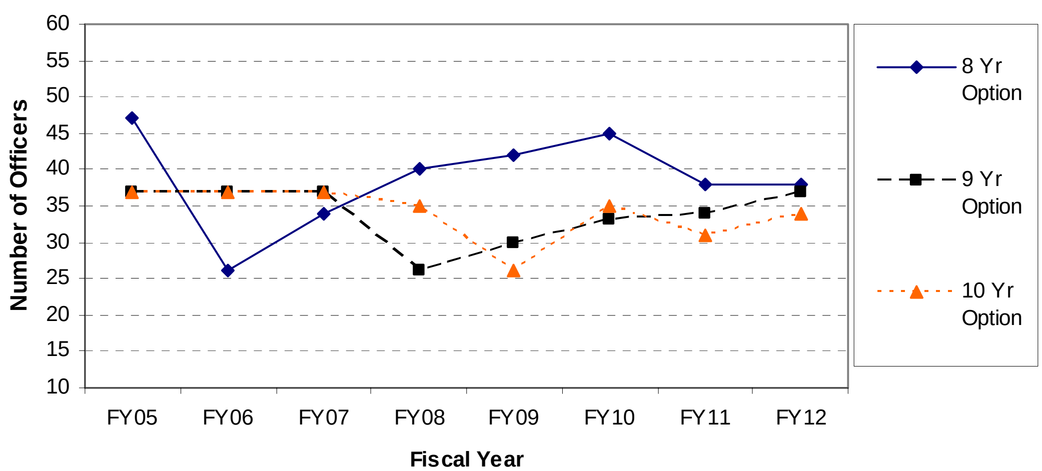

Figure 22: Yearly Educational Requirements for 13S Career Field with Constant Manpower

Based on the preceding analysis for the 61S and 13S career fields, the AADIM-E is capable of producing accurate forecasted results, which, in turn, helps produce estimated long-term educational requirements for graduate programs. Furthermore, the model is useful to identify the effect of manpower trends for the 13S career field that are going to affect both the health of the AAD inventory and the corresponding educational requirements.

AADIM-U

We tested the AADIM-U using four sets of notional officer and assignment data for the 61S career field. Each officer data set is a notional listing of 61S officers with a related AAD degree who are vulnerable to permanent change of stations (PCS) during a given assignment cycle. We constructed officer profiles for each of the seven different attributes discussed in Chapter 3 from the data set obtained from AFPC/DPSAA, AFPC IDEAS website and a personal interview with a 61S Development Team member (15:1). For each of the data sets, we only considered lieutenants (LT), captains (CAPT), and majors (MAJ) vulnerable for a new assignment.

Similarly, each assignment data set is a notional listing of AAD assignments for the 61S career field that are projected to become vacant during an upcoming assignment cycle. This data is primarily constructed from a listing of assignments that require an AAD (8:1). Refer to Appendix F for a detailed explanation of how the notional data was constructed.

Determining the Weighting Constants

We conducted separate interviews with two 61S Development Team members to determine the respective weighting constants for the seven attributes of the AADIM-U

assignment qualification matrix (15:1) (22:1). We use the swing weighting technique described in Chapter 2 to determine the weighting constants. Refer to Appendix G and H for a summary of each interview with the decision makers.

Table 9: Rank Order and Weighting Constants for Decision Maker 1 (22:1)

Attribute	Order	Weighting Constant
Security Clearance	1	0.261
Training Level	1	0.261
Academic Specialty Code (ASC)	2	0.130
Experience Level	2	0.130
DT Vector	3	0.087
Officer Preferences	3	0.087
Grade	4	0.043

Table 10: Rank Order and Weighting Constants for Decision Maker 2 (15:1)

Attribute	Order	Weighting Constant
Academic Specialty Code (ASC)	1	0.504
Security Clearance	2	0.252
DT Vector	3	0.126
Officer Preferences	4	0.063
Experience Level	5	0.031
Training Level	6	0.016
Grade	7	0.008

Sensitivity Analysis

The rank order given by each decision maker determines a unique set of weighting constants that are used to determine the qualification matrix, *A*. We tested each set of weighting constants using four notional data sets consisting of 50 officer and 50 assignments. Refer to Appendix I for the results corresponding to each data set.

Each set of weights, applied to the same data set, yields a different assignment matching solution. On average, 62% of officers have the same assignment matching for both sets of weighting constants.

We performed a sensitivity analysis for each set of weighting constants by varying each weighting constant individually by 5, 10, 15, and 20 percent (plus or minus) while proportionally adjusting the remaining weights to ensure the sum of the weighting factors equal one. Figures 23 and 24 represent, for each decision maker, the average percentage of identical assignments for the three attributes that have the largest weighting constant values. As expected, each weighting constant varies further from the baseline and we observed a greater number of changes in assignment pairings. Note that there are some irregularities, such as the Security Clearance attribute for Decision Maker 1, that do not follow this general trend. This irregularity might be attributable to the characteristics of the data set used. Additional data sets would need to be examined to confirm this conclusion.

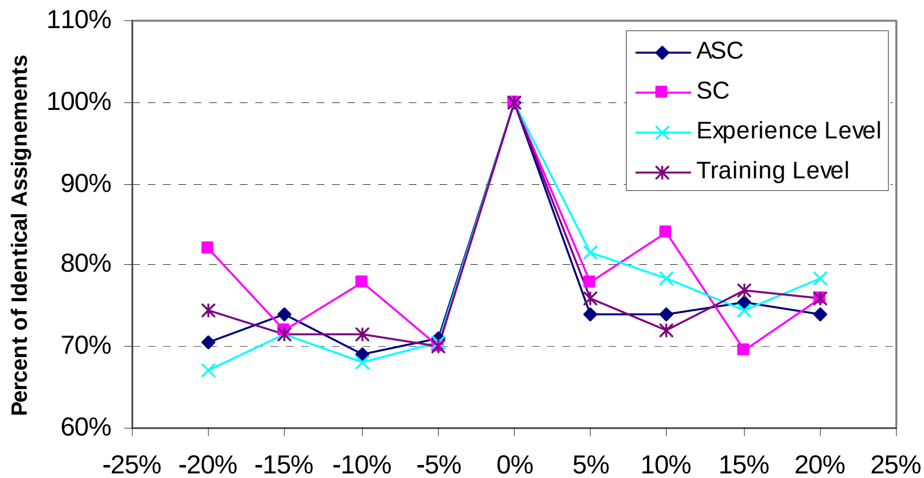

Figure 23: Average Percentage of Identical Assignments for Decision Maker 1

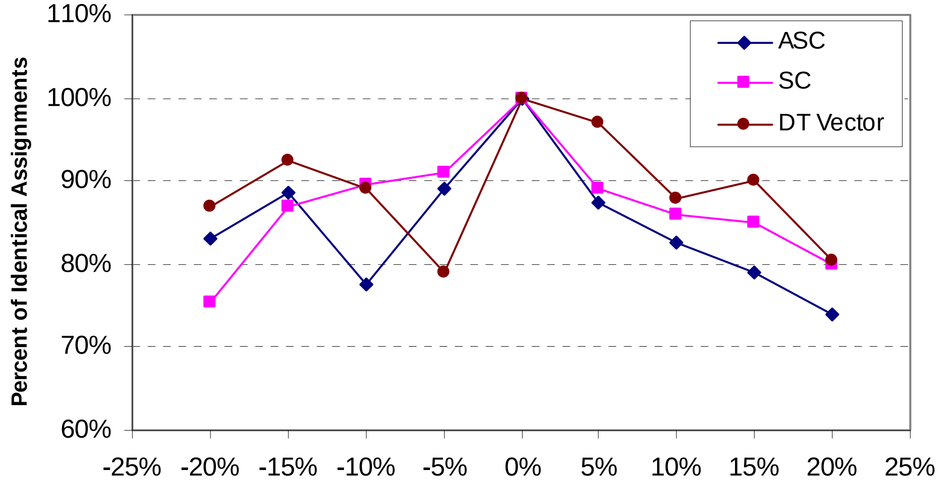

Figure 24: Average Percentage of Identical Assignments for Decision Maker 2

Figures 25 and 26 show the average absolute difference from the baseline objective function for each variation of the weighting constants. Note that varying the weighting constants does not appear to have a large impact on the objective function values. Observe that the changes from the baseline are proportional to the original weight constant value, as well as a function of the percentage of variance applied to that weighting constant.

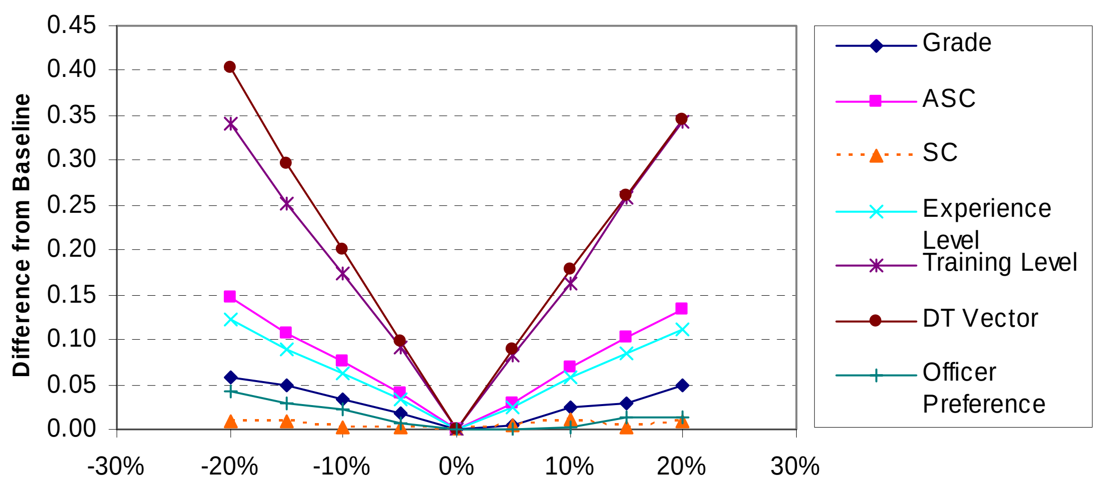

Figure 25: Average Absolute Difference from the Baseline Objective Function for Decision Maker 1

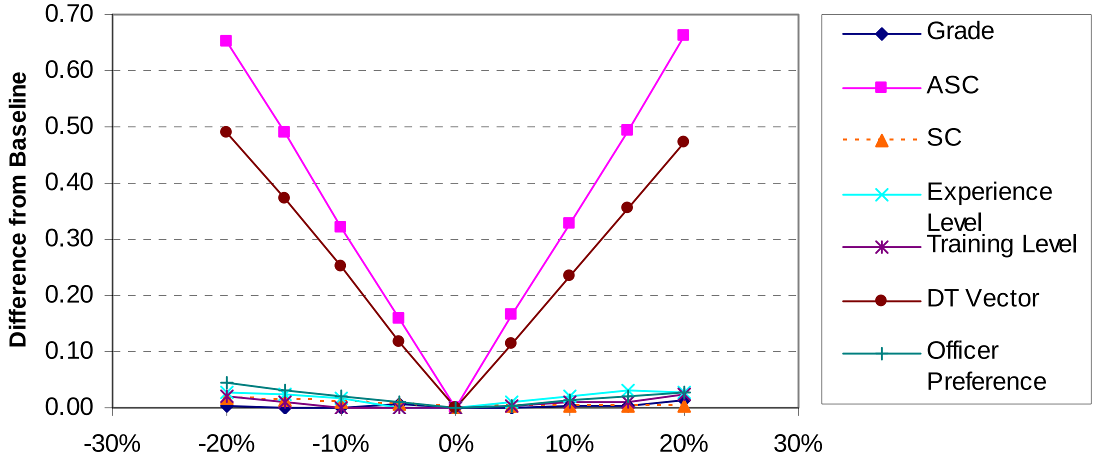

Figure 26: Average Absolute Difference from the Baseline Objective Function for Decision Maker 2

Reducing the Number of Attributes

Recall from Tables 9 and 10 that the lower ranked attributes have a significantly lower weighting constant value than higher ranked attributes. Furthermore, Figures 25 and 26 indicate that there several attributes that have a minimal impact on the objective function value. These factors indicate the possibility that the model could be simplified by eliminating some of the less significant attributes from the model.

With this in mind, we removed Grade and Security Clearance from the desirable qualifications but kept them as required qualifications for an assignment. In addition, we combined Experience Level and Training Level into one attribute. Therefore, the set of desired qualifications was reduced to four attributes (Academic Specialty Code, Experience and Training, DT vector, and Officer Preferences).

We then interviewed both decision makers again and performed the swing weighting technique described in Chapter 2 to determine the weighting constants for the

reduced set of attributes (16:1) (23:1). Refer to Appendices J and K for a summary of the interviews conducted for decision makers 1 and 2, respectively. .

Table 11: Rank Order and Weighting Constants for Decision Maker 1 (23:1)

Attribute	Order	Weighting Constant
Experience and Training Level	1	0.444
DT Vector	2	0.222
Officer Preferences	2	0.222
Academic Specialty Code (ASC)	3	0.112

Table 12: Rank Order and Weighting Constants for Decision Maker 1 (16:1)

Attribute	Order	Weighting Constant
Experience and Training	1	0.533
Academic Specialty Code	2	0.267
DT Vector	3	0.133
Officer Preferences	4	0.067

We observed that each set of weights when applied to the same data set yielded a different assignment matching that results in an optimal solution. On average, 56% of officers had the same assignment matching for both sets of weighting constants from each decision maker in the four-attribute case. There is a 52% and 54% assignment matching between the four-attribute and seven-attribute case for decision makers 1 and 2, respectively.

We performed the same analysis as before. Figures 27 and 28 show the average percentage of identical assignments for each decision maker. As expected, the results for the four-attribute case are similar to the seven-attribute case. There are some irregularities that do not follow the general trend, but as each weighting constant is varied from the baseline, there is a greater number of changes from the baseline. Observe that there are a greater number of changes in the four-attribute case than the seven-attribute case.

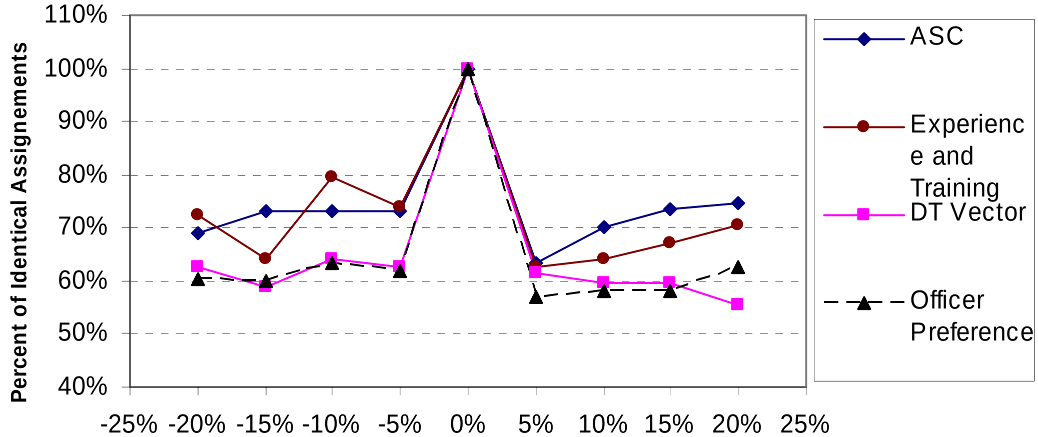

Figure 27: Average Percentage of Identical Assignments for Decision Maker 1

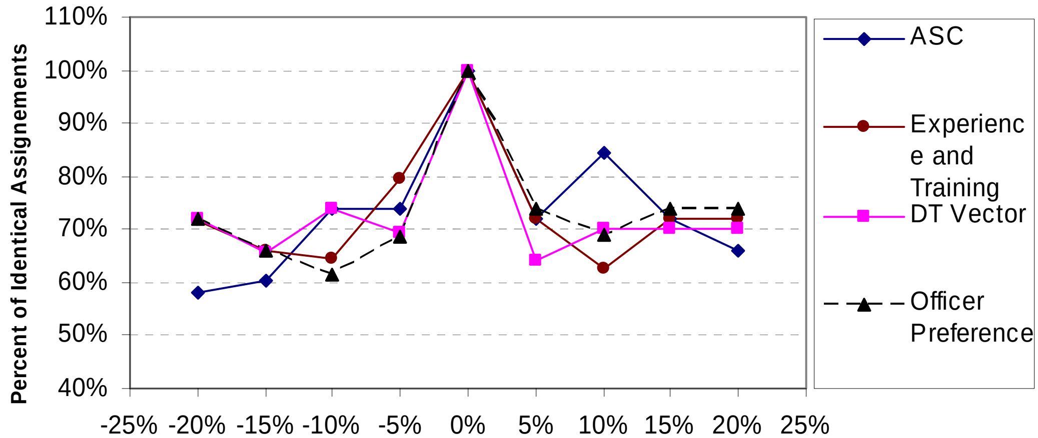

Figure 28: Average Percentage of Identical Assignments for Decision Maker 2

Figures 29 and 30 show similar results as for the previous set of seven attributes, but note that there is a larger impact on the objective function value with respect to changes in the attribute weighting constants than for the seven-attribute case. Refer to Appendix L for the detailed results for decision makers 1 and 2.

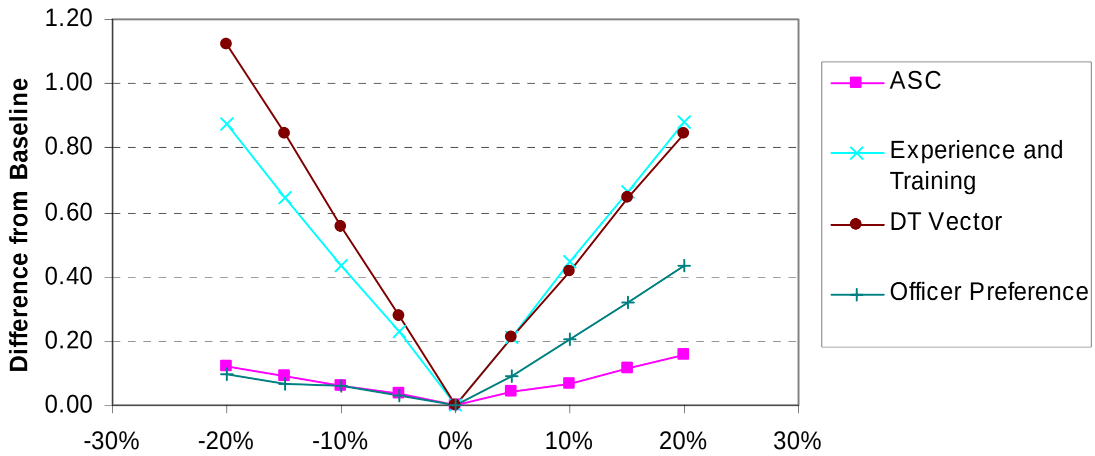

Figure 29: Average Absolute Difference from the Baseline Objective Function for Decision Maker 1

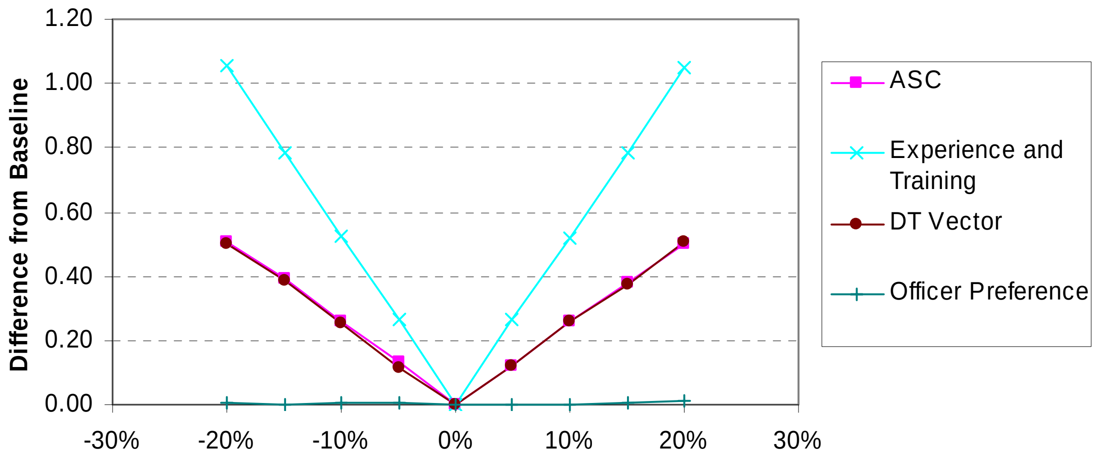

Figure 30: Average Absolute Difference from the Baseline Objective Function for Decision Maker 2

The AADIM-U determines optimal assignment matching given an appropriate set of weighting constants and officer and assignment data. However, the matching is significantly sensitive to the weighting constants determined by each decision maker. That is, the different sets of weighting constants resulted in largely different assignment pairings for the given set of officer and assignment data. Follow-on research is needed to

obtain a well-agreed upon preference structure with regard to the weighting constants, before implementing the AADIM-U using actual AFPC assignment data.

In Chapter 4, we discussed calculations and analysis made using the AADIM-E and AADIM-U. We used historical end-of-fiscal year data from the 61S and 13S career field to evaluate the AADIM-E model, and then, for AADIM-U, we used notional 61S and 13S assignment data. In Chapter 5, we will summarize the research and recommend future avenues for research.

V. Recommendations and Conclusion

Conclusion

For this research effort, we developed the Advanced Academic Degree Inventory Model (AADIM) to help manage the Air Force graduate education program more efficiently and support the objectives of Force Development. AADIM is comprised of an entry (AADIM-E) and utilization (AADIM-U) model which develops graduate education requirements and assigns AAD officers to maintain optimal unit profiles.

The entry model uses current AAD inventory broken out by CYOS and a user-defined idealized educational profile to generate a snapshot of the current "health" of the Advanced Academic Degree (AAD) inventory for any given career field. We then utilize a Markov model developed from historic AAD officer data to forecast the number of officers who are expected to remain part of the AAD inventory. The difference between the forecasted AAD inventory and idealized educational profile for each CYOS group are used to predict the annual educational requirements needed to maintain the aggregate idealized educational percentage.

In our analysis, we showed that AADIM-E is capable of predicting long-term educational requirements for graduate programs. The model is useful to investigate different policies that will impact the size of a given AAD inventory and the resulting educational requirements. Our research concluded that increasing the size of a given career field's AAD inventory must be a long-term initiative. Increasing the AAD inventory in a short period of time causes drastic fluctuations in the forecasted annual educational requirements. It is impractical to expect graduate education programs to

handle short-term surges in student populations, due to funding, staff constraints, academic space, and so forth.

AADIM-E is also designed as a user-friendly tool to forecast graduate educational requirements. The user is easily able to view the current status of the current AAD inventory or at different points in the future. The user can select different idealized educational profiles and experiment with various polices intended to increase the aggregate AAD inventory percentage to the aggregate idealized educational profile within a chosen timeframe and examine the effect on graduate education requirements.

The utilization model determines an optimal assignment matching recommendation for AAD officers. The model generates a score for each officer for each of several qualification criteria, with respect to each available assignment. Using an additive multi-attribute value function developed and calibrated for the model, these scores yield an overall qualification score for each assignment. Finally, we employ a binary integer program formulation to obtain an optimal matching between officers and assignments that maximizes the sum of the qualification scores. Sensitivity analysis on the solutions obtained via the AADIM-U model showed that the assignment pairings are highly sensitive to the weighting constant values that are calibrated via DM interviews.

Very often new AAD officers do not serve in coded billets for the required 36 months during their initial post-education assignment. The AADIM-U model demonstrates a methodology by which an inventory approach can be used vice the current GEMS billet-based approach. An inventory management approach allows AAD officers to move between billets within a pool of billets assigned to a given command. This flexibility provides professional growth opportunities during an assignment for an

officer with an AAD. Further, the AADIM-U provides a mechanism through which AAD officers can (verifiably) continue to serve in positions requiring such expertise, hence extending the benefits to the Air Force that are derived from these officers' education.

Recommendations for Future Research

One of the limitations encountered in AADIM-E is the manpower forecast used to calculate the AAD inventory factor for each CYOS group. We used the Holt linear exponential smoothing technique to forecast the total number of officers in a career field. This technique is easy to use and requires a low amount of computation power. However, it ties future forecasts to past manpower decisions, which may not be appropriate for analyzing potential policies. Further research is needed to develop forecasted manpower levels that do not necessarily rely on past policies. Such policy alternatives might be obtained via office of the Air Force Deputy Chief of Staff, Personnel (AF/DP), and then utilized via an adaptation of the Markov model discussed in Chapter 3.

A more dynamic set of options that specify entrance transition rates for the user should be developed for the user interface. For each of the current four options, a pre-determined set of entrance transition rates, for each fiscal year, are programmed to be increased to the disaggregate idealized educational profile percentage for a specific CYOS group. Further research can focus on creating algorithms that will allow the user to select which CYOS groups' entrance transition rates for each chosen fiscal year that can be adjusted to the achieve the aggregate idealized education profile. Furthermore, an

algorithm should be developed to limit the number of students that can be sent to graduate education programs each year to comply with educational institution constraints.

The analysis of the AADIM-U provided a good demonstration of the model's capabilities, but further analysis is needed by interviewing AFPC assignment officers and development teams for a chosen career field(s) to determine a more definitive set of attributes to include in the model with corresponding weighting factors for the additive multi-attribute value function. It was observed that the decision makers interviewed had a difficult time with rank ordering seven attributes. It is recommended that the number of attributes used in the model be kept to a minimum. Furthermore, it is expected that the potential weighting of the attributes by AFPC might not be the same as the decision makers interviewed in this research. The decision makers are members of a Development Team are tasked with developing officers whereas AFPC is tasked to make sure assignments are filled. These opposing responsibilities may result in different weighing of the attributes.

A thorough validation should be performed by comparing the model's results with the results of an actual AFPC assignment cycle, and it was previously discussed in Chapter 3 that we assumed the property preferential independence between the attributes holds. This assumption should be formally verified.

Appendix A: AADIM-E: 61S Data

Tables 13 – 15 display 61S career field data provided by AFPC/DPSAA that are used to define the transition rate matrices used in AADIM-E. Table 16 shows the total manpower data by CYOS group for the 61S career field (27:1). Tables 17 – 24 are the transition rate matrices for fiscal years 1994 – 2002, and Table 25 is the corresponding average transition rate matrix for fiscal years 1994 – 2002.

Table 13: New Entries for the 61S Career Field

	CYOS													
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
1994	0	1	0	1	2	3	10	11	11	4	7	11	10	71
1995	0	0	0	0	0	2	6	0	1	1	0	0	0	10
1996	0	1	4	1	1	1	2	5	1	0	0	0	1	17
1997	0	0	3	1	1	2	2	1	0	1	0	4	0	15
1998	0	0	6	2	6	3	5	3	1	0	1	1	0	28
1999	0	0	4	0	3	4	0	1	1	0	4	0	0	17
2000	0	0	6	2	2	3	1	4	0	0	0	0	0	18
2001	0	0	3	2	0	1	1	1	0	1	0	0	0	9
2002	0	0	0	3	1	5	1	1	3	1	0	0	0	15
2003	0	0	3	2	4	3	1	1	2	0	1	0	0	17
2004	0	0	4	1	3	3	1	0	1	1	0	0	0	14
Total	0	2	33	15	23	30	30	28	21	9	13	16	11	231

Table 14: System Movement for the 61S Career Field

	CYOS													
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	1	0	1	2	3	9	10	9	4	6	11	56
1996	0	0	0	1	0	1	2	9	6	10	9	3	3	44
1997	0	0	1	4	2	0	1	2	14	5	9	9	3	50
1998	0	0	0	4	5	3	2	3	3	9	5	6	11	51
1999	0	0	0	6	6	9	5	5	6	3	6	3	6	55
2000	0	0	0	4	5	9	9	3	5	4	3	8	3	53
2001	0	0	0	6	5	7	11	10	6	3	2	3	8	61
2002	0	0	0	3	7	4	7	10	10	5	3	2	3	54
2003	0	0	0	0	3	7	7	6	10	12	5	3	2	55
2004	0	0	0	3	2	7	10	8	6	11	11	6	3	67
Total	0	0	2	31	36	49	57	65	76	71	57	49	53	546

Table 15: Total Number of AAD Officers for the 61S Career Field

	CYOS													
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
1994	0	1	0	1	2	3	10	11	11	4	7	11	10	71
1995	0	0	1	0	1	4	9	9	11	10	4	6	11	66
1996	0	1	4	2	1	2	4	14	7	10	9	3	4	61
1997	0	0	4	5	3	2	3	3	14	6	9	13	3	65
1998	0	0	6	6	11	6	7	6	4	9	6	7	11	79
1999	0	0	4	6	9	13	5	6	7	3	10	3	6	72
2000	0	0	6	6	7	12	10	7	5	4	3	8	3	71
2001	0	0	3	8	5	8	12	11	6	4	2	3	8	70
2002	0	0	0	6	8	9	8	11	13	6	3	2	3	69
2003	0	0	3	2	7	10	8	7	12	12	6	3	2	72
2004	0	0	4	4	5	10	11	8	7	12	11	6	3	81
Total	0	2	35	46	59	79	87	93	97	80	70	65	64	777

Table 16: Total Yearly Manning for the 61S Career Field

	CYOS												
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total**
1994	1	32	92	79	38	70	56	52	76	55	56	77	684
1995	5	10	32	77	74	36	66	53	46	69	48	52	568
1996	19	94	94	92	66	65	39	55	48	43	60	47	722
1997	64	76	96	93	81	60	60	36	49	41	45	56	757
1998	51	67	81	92	79	69	57	52	37	42	34	41	702
1999	52	69	66	77	84	64	62	51	48	36	45	34	688
2000	68	71	76	67	64	66	60	53	47	44	33	40	689
2001	21	81	71	72	57	51	60	52	47	41	44	31	628
2002	16	93	86	70	61	52	45	52	48	45	40	42	650
2003	37	119	104	86	70	54	42	42	52	47	42	35	730
2004	26	146	119	107	68	66	47	45	40	51	49	42	806
Total	360	858	917	912	742	653	594	543	538	514	496	497	7624

Table 17: FY94 – FY95 Transition Rate Matrix for 61S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	1.00	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0.900	0	0	0	0	0.100
7	0	0	0	0	0	0	0	0	0.909	0	0	0	0.091
8	0	0	0	0	0	0	0	0	0	0.818	0	0	0.182
9	0	0	0	0	0	0	0	0	0	0	1.00	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0.857	0.143
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 18: FY95 – FY96 Transition Rate Matrix for 61S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.500	0	0	0	0	0	0.500
6	0	0	0	0	0	0	0	1.00	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0.667	0	0	0	0.333
8	0	0	0	0	0	0	0	0	0	0.909	0	0	0.091
9	0	0	0	0	0	0	0	0	0	0	0. 900	0	0.100
10	0	0	0	0	0	0	0	0	0	0	0	0.750	0.250
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 19: FY96 – FY97 Transition Rate Matrix for 61S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.500	0	0	0	0	0	0.500
6	0	0	0	0	0	0	0	0.500	0	0	0	0	0.500
7	0	0	0	0	0	0	0	0	1.00	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0.714	0	0	0.286
9	0	0	0	0	0	0	0	0	0	0	0. 900	0	0.100
10	0	0	0	0	0	0	0	0	0	0	0	1.00	0
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 20: FY97 – FY98 Transition Rate Matrix for 61S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	1.00	0	0	0	0	0	0
6	0	0	0	0	0	0	0	1.00	0	0	0	0	0
7	0	0	0	0	0	0	0	0	1.00	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0.643	0	0	0.357
9	0	0	0	0	0	0	0	0	0	0	0. 833	0	0.167
10	0	0	0	0	0	0	0	0	0	0	0	0.667	0.333
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 21: FY98 – FY99 Transition Rate Matrix for 61S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.833	0	0	0	0	0	0.167
6	0	0	0	0	0	0	0	0.714	0	0	0	0	0.286
7	0	0	0	0	0	0	0	0	1.00	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0.750	0	0	0.250
9	0	0	0	0	0	0	0	0	0	0	0. 667	0	0.333
10	0	0	0	0	0	0	0	0	0	0	0	0.500	0.500
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 22: FY99 – FY00 Transition Rate Matrix for 61S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.692	0	0	0	0	0	0.308
6	0	0	0	0	0	0	0	0.600	0	0	0	0	0.400
7	0	0	0	0	0	0	0	0	0.833	0	0	0	0.167
8	0	0	0	0	0	0	0	0	0	0.571	0	0	0.429
9	0	0	0	0	0	0	0	0	0	0	1.00	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0.800	0.200
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 23: FY00 – FY01 Transition Rate Matrix for 61S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.917	0	0	0	0	0	0.083
6	0	0	0	0	0	0	0	1.00	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0.857	0	0	0	0.143
8	0	0	0	0	0	0	0	0	0	0.600	0	0	0.400
9	0	0	0	0	0	0	0	0	0	0	0.500	0	0.500
10	0	0	0	0	0	0	0	0	0	0	0	1.00	0
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 24: FY01 – FY02 Transition Rate Matrix for 61S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.875	0	0	0	0	0	0.125
6	0	0	0	0	0	0	0	0.833	0	0	0	0	0.167
7	0	0	0	0	0	0	0	0	0.909	0	0	0	0.091
8	0	0	0	0	0	0	0	0	0	0.833	0	0	0.167
9	0	0	0	0	0	0	0	0	0	0	0. 750	0	0.250
10	0	0	0	0	0	0	0	0	0	0	0	1.00	0
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 25: Average Transition Rate Matrix for 61S Career Field Initialization Set

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.790	0	0	0	0	0	0.210
6	0	0	0	0	0	0	0	0.818	0	0	0	0	0.182
7	0	0	0	0	0	0	0	0	0.897	0	0	0	0.103
8	0	0	0	0	0	0	0	0	0	0.730	0	0	0.270
9	0	0	0	0	0	0	0	0	0	0	0.819	0	0.181
10	0	0	0	0	0	0	0	0	0	0	0	0.822	0.178
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Appendix B: AADIM-E: 13S Data

Tables 26 – 28 show 13S career field data provided by AFPC/DPSAA that is used to develop the transition rate matrices used in AADIM-E. Table 29 shows the total manpower data by CYOS group for the 13S career field (27:1). Tables 30 – 37 are the transition rate matrices for fiscal years 1994 – 2002, and Table 38 is the corresponding average transition rate matrix for fiscal years 1994 – 2002.

Table 26: New Entries for the 13S Career Field

	CYOS													
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
1994	0	0	0	1	5	9	9	13	10	8	14	11	9	89
1995	0	0	0	1	3	4	8	2	3	3	0	2	1	27
1996	0	0	0	1	0	2	0	2	1	4	2	4	0	16
1997	0	0	0	0	4	0	2	0	1	1	0	0	1	9
1998	0	0	0	0	2	2	3	1	1	1	0	0	0	10
1999	0	0	7	0	1	3	2	1	0	0	0	0	0	14
2000	0	0	4	0	0	0	3	1	0	1	1	0	0	10
2001	0	0	0	0	1	0	2	0	1	1	0	0	1	6
2002	0	0	0	0	1	1	0	0	3	0	0	0	0	5
2003	0	0	0	0	0	0	0	1	1	0	2	0	1	5
2004	0	0	0	0	0	0	2	1	0	0	1	2	1	7
Total	0	0	11	3	17	21	31	22	21	19	20	19	14	198

Table 27: System Movement for the 13S Career Field

	CYOS													
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	1	4	8	9	13	10	7	9	11	72
1996	0	0	0	0	1	2	8	16	10	16	11	7	10	81
1997	0	0	0	0	0	0	4	7	17	11	20	12	10	81
1998	0	0	0	0	0	4	0	6	6	18	11	17	10	72
1999	0	0	0	0	0	2	5	3	7	7	17	10	17	68
2000	0	0	0	5	0	1	4	6	4	5	7	14	10	56
2001	0	0	0	4	5	0	1	6	7	4	6	7	14	54
2002	0	0	0	0	2	5	0	3	6	8	4	6	6	40
2003	0	0	0	0	0	2	3	0	3	9	8	4	6	35
2004	0	0	0	0	0	0	2	3	1	4	9	10	4	33
Total	0	0	0	9	9	20	35	59	74	92	100	96	98	592

Table 28: Total Number of AAD Officers for the 13S Career Field

	CYOS													
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
1994	0	0	0	1	5	9	9	13	10	8	14	11	9	89
1995	0	0	0	1	4	8	16	11	16	13	7	11	12	99
1996	0	0	0	1	1	4	8	18	11	20	13	11	10	97
1997	0	0	0	0	4	0	6	7	18	12	20	12	11	90
1998	0	0	0	0	2	6	3	7	7	19	11	17	10	82
1999	0	0	7	0	1	5	7	4	7	7	17	10	17	82
2000	0	0	4	5	0	1	7	7	4	6	8	14	10	66
2001	0	0	0	4	6	0	3	6	8	5	6	7	15	60
2002	0	0	0	0	3	6	0	3	9	8	4	6	6	45
2003	0	0	0	0	0	2	3	1	4	9	10	4	7	40
2004	0	0	0	0	0	0	4	4	1	4	10	12	5	40
Total	0	0	11	12	26	41	66	81	95	111	120	115	112	790

Table 29: Total Yearly Manning for the 13S Career Field

	CYOS												
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total**
1994	0	18	122	259	210	313	166	180	173	125	146	175	1887
1995	288	215	344	345	352	193	295	151	161	154	108	130	2736
1996	5	249	253	316	299	312	181	279	146	161	154	115	2470
1997	89	245	249	254	294	280	301	165	251	135	151	145	2559
1998	61	207	252	224	237	263	265	274	154	236	129	145	2447
1999	10	61	203	239	230	186	236	232	253	142	221	128	2141
2000	132	270	198	211	223	189	205	200	214	230	137	205	2414
2001	92	179	267	194	174	189	169	180	190	208	212	125	2179
2002	28	112	176	255	177	150	181	153	165	186	203	200	1986
2003	56	168	126	144	184	139	132	178	175	134	184	189	1809
2004	104	161	225	235	160	159	127	125	184	168	134	178	1960
Total	865	1885	2415	2676	2540	2373	2258	2117	2066	1879	1779	1735	24588

Table 30: FY94 – FY95 Transition Rate Matrix for 13S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.889	0	0	0	0	0	0.111
6	0	0	0	0	0	0	0	1.00	0	0	0	0	0
7	0	0	0	0	0	0	0	0	1.00	0	0	0	0
8	0	0	0	0	0	0	0	0	0	1.00	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0.875	0	0125.
10	0	0	0	0	0	0	0	0	0	0	0	0.643	0.357
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 31: FY95 – FY96 Transition Rate Matrix for 13S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	1.00	0	0	0	0	0	0
6	0	0	0	0	0	0	0	1.00	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0.909	0	0	0	0.091
8	0	0	0	0	0	0	0	0	0	1.00	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0.846	0	0.154
10	0	0	0	0	0	0	0	0	0	0	0	1.00	0
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 32: FY96 – FY97 Transition Rate Matrix for 13S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	1.00	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0.875	0	0	0	0	0.125
7	0	0	0	0	0	0	0	0	0.944	0	0	0	0.056
8	0	0	0	0	0	0	0	0	0	1.00	0	0	0
9	0	0	0	0	0	0	0	0	0	0	1.00	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0.909	0.077
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 33: FY97 – FY98 Transition Rate Matrix for 13S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	1.00	0	0	0	0	0	0
6	0	0	0	0	0	0	0	1.00	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0.857	0	0	0	0.143
8	0	0	0	0	0	0	0	0	0	1.00	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0.917	0	0.083
10	0	0	0	0	0	0	0	0	0	0	0	0.850	0.150
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 34: FY98 – FY99 Transition Rate Matrix for 13S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.833	0	0	0	0	0	0.167
6	0	0	0	0	0	0	0	1.00	0	0	0	0	0
7	0	0	0	0	0	0	0	0	1.00	0	0	0	0
8	0	0	0	0	0	0	0	0	0	1.00	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0.895	0	0.105
10	0	0	0	0	0	0	0	0	0	0	0	0.909	0.091
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 35: FY99 – FY00 Transition Rate Matrix for 13S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.800	0	0	0	0	0	0.200
6	0	0	0	0	0	0	0	0.857	0	0	0	0	0.143
7	0	0	0	0	0	0	0	0	1.00	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0.714	0	0	0.286
9	0	0	0	0	0	0	0	0	0	0	1.00	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0.824	0.176
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 36: FY00 – FY01 Transition Rate Matrix for 13S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	1.00	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0.857	0	0	0	0	0.143
7	0	0	0	0	0	0	0	0	1.00	0	0	0	0
8	0	0	0	0	0	0	0	0	0	1.00	0	0	0
9	0	0	0	0	0	0	0	0	0	0	1.00	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0.875	0.125
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 37: FY01 – FY02 Transition Rate Matrix for 13S Career Field

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	1.00	0	0	0	0	0	0
6	0	0	0	0	0	0	0	1.00	0	0	0	0	0
7	0	0	0	0	0	0	0	0	1.00	0	0	0	0
8	0	0	0	0	0	0	0	0	0	1.00	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0.800	0	0.200
10	0	0	0	0	0	0	0	0	0	0	0	1.00	0
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 38: Average Transition Rate Matrix for 13S Career Field Initialization Set

CYOS	0	1	2	3	4	5	6	7	8	9	10	11	Exit
0	0	1.00	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1.00	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1.00	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1.00	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1.00	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0.949	0	0	0	0	0	0.060
6	0	0	0	0	0	0	0	0.949	0	0	0	0	0.060
7	0	0	0	0	0	0	0	0	0.964	0	0	0	0.036
8	0	0	0	0	0	0	0	0	0	0.964	0	0	0.036
9	0	0	0	0	0	0	0	0	0	0	0.917	0	0.083
10	0	0	0	0	0	0	0	0	0	0	0	0.878	0.122
11	0	0	0	0	0	0	0	0	0	0	0	0	1

Appendix C: AADIM-E Results for 61S Career Field

Tables 39 – 50 are the 61S career field AAD inventories, education requirements, and entrance transition rates for each of the four graduate education policies used in AADIM-E.

Table 39: 61S Career Field AAD Inventory by CYOS Using the 4-Year Option

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	6	8	9	8	11	13	6	3	2	66
FY03	0	0	3	2	10	11	8	8	12	9	6	2	71
FY04	0	0	4	4	5	13	10	7	8	10	8	5	72
FY05	0	0	16	4	4	17	21	22	6	6	8	6	110
FY06	0	0	14	16	4	17	20	18	21	23	22	26	180
FY07	0	0	14	14	16	16	20	17	20	22	21	25	187
FY08	0	0	14	14	14	16	19	17	20	22	21	25	182
FY09	0	0	14	14	14	15	19	16	19	21	20	25	179

Table 40: 61S Career Field Educational Requirements by CYOS Using the 4-Year Option

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	17	0	0	13	12	15	0	0	0	0	0	0	57
FY06	16	0	0	14	8	1	1	19	18	21	0	0	98
FY07	15	0	0	13	7	1	5	8	3	8	0	0	60
FY08	15	0	0	1	7	1	5	8	3	8	0	0	48
FY09	15	0	0	1	7	1	5	8	3	8	0	0	48

Table 41: 61S Career Field Entrance Transition Rates by CYOS Using the 4-Year Option

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.215	0.000	0.000	0.219	0.237	0.346	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.204	0.000	0.000	0.238	0.165	0.007	0.024	0.443	0.438	0.482
FY07	0.000	0.000	0.204	0.000	0.000	0.231	0.159	0.024	0.146	0.243	0.109	0.256
FY08	0.000	0.000	0.204	0.000	0.000	0.006	0.164	0.022	0.143	0.240	0.108	0.259
FY09	0.000	0.000	0.204	0.000	0.000	0.023	0.164	0.020	0.143	0.240	0.107	0.269

Table 42: 61S Career Field AAD Inventory by CYOS Using the 5-Year Option

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	6	8	9	8	11	13	6	3	2	66
FY03	0	0	3	2	10	11	8	8	12	9	6	2	71
FY04	0	0	4	4	5	13	10	7	8	10	8	5	72
FY05	0	0	15	4	4	26	21	8	6	6	8	6	104
FY06	0	0	14	15	4	17	21	18	21	4	5	6	125
FY07	0	0	14	14	15	16	20	17	20	22	21	25	186
FY08	0	0	14	14	14	16	19	17	20	22	21	25	182
FY09	0	0	14	14	14	15	19	16	19	21	20	25	179

Table 43: 61S Career Field Educational Requirements by CYOS Using the 5-Year Option

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	16	0	0	22	12	0	0	0	0	0	0	0	50
FY06	15	0	0	14	2	0	14	0	0	0	0	0	45
FY07	15	0	0	13	8	0	5	8	19	23	0	0	91
FY08	15	0	0	2	7	1	5	8	3	8	0	0	49
FY09	15	0	0	2	7	1	5	8	3	8	0	0	49

Table 44: 61S Career Field Entrance Transition Rates by CYOS Using the 5-Year Option

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.204	0.000	0.000	0.380	0.245	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.202	0.000	0.000	0.232	0.027	0.000	0.332	0.000	0.000	0.000
FY07	0.000	0.000	0.204	0.000	0.000	0.231	0.164	0.000	0.144	0.241	0.450	0.506
FY08	0.000	0.000	0.204	0.000	0.000	0.026	0.164	0.022	0.142	0.240	0.108	0.259
FY09	0.000	0.000	0.204	0.000	0.000	0.027	0.164	0.020	0.143	0.240	0.107	0.269

Table 45: 61S Career Field AAD Inventory by CYOS Using the 6-Year Option

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	6	8	9	8	11	13	6	3	2	66
FY03	0	0	3	2	10	11	8	8	12	9	6	2	71
FY04	0	0	4	4	5	13	10	7	8	10	8	5	72
FY05	0	0	16	4	4	26	10	8	6	6	8	6	93
FY06	0	0	14	16	4	25	21	23	7	4	5	6	126
FY07	0	0	14	14	16	19	20	17	27	5	4	4	141
FY08	0	0	14	14	14	16	19	17	20	22	21	25	182
FY09	0	0	14	14	14	15	19	16	19	21	20	25	179

Table 46: 61S Career Field Educational Requirements by CYOS Using the 6-Year Option

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	17	0	0	22	0	0	0	0	0	0	0	0	39
FY06	16	0	0	22	1	15	0	0	0	0	0	0	54
FY07	15	0	0	16	1	0	8	0	0	0	0	0	40
FY08	15	0	0	1	5	1	5	2	18	23	0	0	70
FY09	15	0	0	1	7	1	5	8	3	8	0	0	48

Table 47: 61S Career Field Entrance Transition Rates

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.217	0.000	0.000	0.380	0.000	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.204	0.000	0.000	0.390	0.026	0.358	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.204	0.000	0.000	0.284	0.013	0.000	0.266	0.000	0.000	0.000
FY08	0.000	0.000	0.204	0.000	0.000	0.004	0.115	0.010	0.143	0.076	0.439	0.516
FY09	0.000	0.000	0.204	0.000	0.000	0.023	0.164	0.020	0.143	0.240	0.107	0.269

Table 48: 61S Career Field AAD Inventory by CYOS Using the 7-Year Option

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	6	8	9	8	11	13	6	3	2	66
FY03	0	0	3	2	10	11	8	8	12	9	6	2	71
FY04	0	0	4	4	5	13	10	7	8	10	8	5	72
FY05	0	0	0	4	4	27	27	23	6	6	8	6	111
FY06	0	0	15	0	4	25	21	25	21	4	5	6	126
FY07	0	0	14	15	0	25	21	22	30	15	4	4	149
FY08	0	0	14	14	15	16	20	18	20	22	27	3	169
FY09	0	0	14	14	14	15	19	16	19	21	20	25	179

Table 49: 61S Career Field Educational Requirements by CYOS Using the 7-Year Option

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	0	0	0	23	18	16	0	0	0	0	0	0	57
FY06	16	0	0	22	1	3	0	0	0	0	0	0	42
FY07	15	0	0	22	1	6	9	0	0	0	0	0	53
FY08	15	0	0	17	1	2	0	0	16	0	0	0	51
FY09	15	0	0	1	7	1	4	8	3	3	0	0	42

Table 50: 61S Career Field Entrance Transition Rates

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.000	0.000	0.000	0.401	0.376	0.369	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.213	0.000	0.000	0.390	0.000	0.091	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.204	0.000	0.000	0.389	0.024	0.164	0.308	0.000	0.000	0.000
FY08	0.000	0.000	0.204	0.000	0.000	0.285	0.004	0.043	0.000	0.000	0.500	0.000
FY09	0.000	0.000	0.204	0.000	0.000	0.007	0.164	0.017	0.109	0.240	0.107	0.101

Appendix D: AADIM-E Results for 13S Career Field

Tables 51 – 62 are the 13S career field AAD inventories, education requirements, and entrance transition rates for each graduate education policy using decreasing total manpower in AADIM-E. Tables 63 – 74 are the 13S career field AAD inventories, education requirements, and entrance transition rates for each graduate education policy using increasing total manpower in AADIM-E. Tables 75 – 95 are the 13S career field AAD inventories, education requirements, and entrance transition rates for each graduate education policy using constant total manpower in AADIM-E.

Table 51: 13S Career Field AAD Inventory by CYOS Using the 4-Year Option (Decreasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	0	5	6	1	4	9	10	35
FY04	0	0	8	0	0	14	16	15	6	1	3	8	72
FY05	0	0	7	8	0	12	14	15	15	14	13	15	114
FY06	0	0	6	7	8	10	12	13	15	14	13	13	110
FY07	0	0	4	6	7	8	10	11	12	14	13	12	97
FY08	0	0	3	4	6	7	8	9	11	12	13	12	84
FY09	0	0	0	0	0	3	6	1	4	9	9	4	35

Table 52: 13S Career Field Educational Requirements by CYOS Using the 4-Year Option (Decreasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	11	0	0	19	21	15	0	0	0	0	0	0	66
FY06	10	0	0	17	0	0	1	12	17	18	0	0	75
FY07	9	0	0	15	0	0	0	0	0	2	0	0	26
FY08	7	0	0	1	0	0	0	0	0	0	0	0	8
FY09	6	0	0	0	0	0	0	0	0	0	0	0	6

Table 53: 13S Career Field Entrance Transition Rates by CYOS Using the 4-Year Option (Decreasing Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.060	0.000	0.000	0.097	0.115	0.090	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.060	0.000	0.000	0.098	0.000	0.000	0.001	0.108	0.161	0.170
FY07	0.000	0.000	0.060	0.000	0.000	0.098	0.000	0.000	0.000	0.000	0.000	0.025
FY08	0.000	0.000	0.060	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
FY09	0.000	0.000	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 54: 13S Career Field AAD Inventory by CYOS Using the 5-Year Option (Decreasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	0	5	6	1	4	9	10	35
FY04	0	0	8	0	0	14	13	5	6	1	3	8	59
FY05	0	0	6	8	0	12	14	13	12	6	1	3	75
FY06	0	0	6	6	8	10	11	13	12	12	11	13	102
FY07	0	0	4	6	6	8	10	11	12	12	11	11	91
FY08	0	0	3	4	6	6	8	9	10	12	11	10	79
FY09	0	0	0	0	0	3	6	1	4	9	9	4	35

Table 55: 13S Career Field Educational Requirements by CYOS Using the 5-Year Option (Decreasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	11	0	0	19	18	0	0	0	0	0	0	0	48
FY06	9	0	0	17	0	1	11	0	0	0	0	0	38
FY07	9	0	0	15	1	0	0	0	8	18	0	0	51
FY08	7	0	0	1	0	0	0	0	0	3	0	0	11
FY09	6	0	0	0	0	0	0	0	0	0	0	0	6

Table 56: 13S Career Field Entrance Transition Rates by CYOS Using the 5-Year Option (Decreasing Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.060	0.000	0.000	0.097	0.098	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.057	0.000	0.000	0.095	0.000	0.000	0.084	0.000	0.000	0.000
FY07	0.000	0.000	0.060	0.000	0.000	0.098	0.000	0.000	0.000	0.000	0.091	0.194
FY08	0.000	0.000	0.060	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.039
FY09	0.000	0.000	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 57: 13S Career Field AAD Inventory by CYOS Using the 6-Year Option (Decreasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	3	6	1	4	9	9	4	35
FY04	0	0	0	0	0	0	5	6	1	4	9	10	35
FY05	0	0	8	0	0	11	0	5	6	1	3	8	42
FY06	0	0	7	8	0	12	11	12	4	6	1	3	64
FY07	0	0	5	7	8	10	11	10	12	4	5	1	73
FY08	0	0	4	5	7	8	9	11	10	12	8	10	84
FY09	0	0	3	4	5	7	8	8	10	10	11	7	73

Table 58: 13S Career Field Educational Requirements by CYOS Using the 6-Year Option (Decreasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	11	0	0	15	0	0	0	0	0	0	0	0	26
FY06	9	0	0	17	0	17	0	0	0	0	0	0	43
FY07	8	0	0	14	0	0	0	0	0	0	0	0	22
FY08	7	0	0	1	0	0	0	0	8	9	0	0	25
FY09	6	0	0	0	0	0	0	0	0	0	0	0	6

Table 59: 13S Career Field Entrance Transition Rates by CYOS Using the 6-Year Option (Decreasing Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.060	0.000	0.000	0.077	0.000	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.057	0.000	0.000	0.095	0.000	0.116	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.055	0.000	0.000	0.091	0.000	0.000	0.000	0.000	0.000	0.000
FY08	0.000	0.000	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.099	0.118
FY09	0.000	0.000	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 60: 13S Career Field AAD Inventory by CYOS Using the 7-Year Option (Decreasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	0	5	6	1	4	9	10	35
FY04	0	0	0	0	0	11	11	10	6	1	3	8	50
FY05	0	0	6	0	0	10	11	11	10	6	1	3	57
FY06	0	0	5	6	0	9	9	10	11	9	5	1	65
FY07	0	0	4	5	6	7	9	9	10	10	8	5	72
FY08	0	0	3	4	5	6	7	8	8	10	9	7	67
FY09	0	0	0	0	0	3	6	1	4	9	9	4	35

Table 61: 13S Career Field Educational Requirements by CYOS Using the 7-Year Option (Decreasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	0	0	0	15	14	8	0	0	0	0	0	0	37
FY06	8	0	0	14	0	2	0	0	0	0	0	0	24
FY07	7	0	0	14	0	0	0	0	0	0	0	0	21
FY08	7	0	0	11	0	0	0	0	0	0	0	0	18
FY09	6	0	0	0	0	0	0	0	0	0	0	0	6

Table 62: 13S Career Field Entrance Transition Rates by CYOS Using the 7-Year Option (Decreasing Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.000	0.000	0.000	0.077	0.076	0.044	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.052	0.000	0.000	0.077	0.000	0.010	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.050	0.000	0.000	0.090	0.000	0.000	0.000	0.000	0.000	0.000
FY08	0.000	0.000	0.054	0.000	0.000	0.085	0.000	0.000	0.000	0.000	0.000	0.000
FY09	0.000	0.000	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 63: 13S Career Field AAD Inventory by CYOS Using the 4-Year Option (Increasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	3	6	1	4	9	9	4	35
FY04	0	0	0	0	0	0	5	6	1	4	9	10	35
FY05	0	0	17	0	0	28	31	32	6	1	3	8	125
FY06	0	0	19	17	0	28	32	30	38	35	33	38	269
FY07	0	0	18	19	17	33	37	34	40	39	35	41	313
FY08	0	0	20	18	19	37	40	37	44	43	38	46	342
FY09	0	0	22	20	18	40	44	41	49	47	42	50	374

Table 64: 13S Career Field Educational Requirements by CYOS Using the 4-Year Option (Increasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	14	0	0	23	26	23	0	0	0	0	0	0	86
FY06	16	0	0	24	5	2	6	24	27	29	0	0	133
FY07	16	0	0	28	9	3	9	2	3	11	0	0	81
FY08	17	0	0	17	8	2	10	3	3	13	0	0	73
FY09	19	0	0	18	9	2	11	4	3	14	0	0	80

Table 65: 13S Career Field Entrance Transition Rates by CYOS Using the 4-Year Option (Increasing Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.066	0.000	0.000	0.098	0.117	0.119	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.067	0.000	0.000	0.091	0.023	0.006	0.031	0.145	0.170	0.190
FY07	0.000	0.000	0.060	0.000	0.000	0.098	0.036	0.012	0.046	0.013	0.016	0.074
FY08	0.000	0.000	0.060	0.000	0.000	0.056	0.029	0.007	0.046	0.018	0.016	0.078
FY09	0.000	0.000	0.060	0.000	0.000	0.055	0.029	0.007	0.046	0.018	0.015	0.077

Table 66: 13S Career Field AAD Inventory by CYOS Using the 5-Year Option (Increasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	3	6	1	4	9	9	4	35
FY04	0	0	0	0	0	0	5	6	1	4	9	10	35
FY05	0	0	19	0	0	36	32	5	6	1	3	8	110
FY06	0	0	17	19	0	38	33	30	39	6	1	3	186
FY07	0	0	19	17	19	33	37	33	40	42	36	41	318
FY08	0	0	20	19	17	37	40	37	44	43	39	46	341
FY09	0	0	22	20	19	40	44	41	49	47	42	50	374

Table 67: 13S Career Field Educational Requirements by CYOS Using the 5-Year Option (Increasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	17	0	0	30	27	0	0	0	0	0	0	0	74
FY06	14	0	0	32	0	0	29	0	0	0	0	0	75
FY07	16	0	0	28	1	2	9	4	25	34	0	0	119
FY08	17	0	0	15	8	2	10	3	0	12	0	0	67
FY09	19	0	0	20	9	2	11	4	3	13	0	0	81

Table 68: 13S Career Field Entrance Transition Rates by CYOS Using the 5-Year Option (Increasing Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.077	0.000	0.000	0.126	0.123	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.060	0.000	0.000	0.123	0.000	0.000	0.146	0.000	0.000	0.000
FY07	0.000	0.000	0.061	0.000	0.000	0.098	0.004	0.007	0.046	0.026	0.150	0.200
FY08	0.000	0.000	0.060	0.000	0.000	0.049	0.029	0.008	0.046	0.018	0.000	0.075
FY09	0.000	0.000	0.060	0.000	0.000	0.060	0.029	0.007	0.046	0.018	0.015	0.076

Table 69: 13S Career Field AAD Inventory by CYOS Using the 6-Year Option (Increasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	3	6	1	4	9	9	4	35
FY04	0	0	0	0	0	0	5	6	1	4	9	10	35
FY05	0	0	19	0	0	37	0	5	6	1	3	8	80
FY06	0	0	21	19	0	39	35	42	4	6	1	3	171
FY07	0	0	18	21	19	34	37	34	44	4	5	1	217
FY08	0	0	20	18	21	37	40	37	44	43	38	46	345
FY09	0	0	22	20	18	40	44	41	49	47	42	50	374

Table 70: 13S Career Field Educational Requirements by CYOS Using the 6-Year Option (Increasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	17	0	0	31	0	0	0	0	0	0	0	0	48
FY06	18	0	0	33	1	35	0	0	0	0	0	0	87
FY07	16	0	0	28	1	0	4	0	0	0	0	0	49
FY08	17	0	0	15	8	2	10	1	29	34	0	0	116
FY09	19	0	0	16	9	2	11	4	3	14	0	0	78

Table 71: 13S Career Field Entrance Transition Rates by CYOS Using the 6-Year Option (Increasing Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.077	0.000	0.000	0.133	0.000	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.077	0.000	0.000	0.126	0.001	0.160	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.060	0.000	0.000	0.099	0.000	0.000	0.017	0.000	0.000	0.000
FY08	0.000	0.000	0.060	0.000	0.000	0.049	0.028	0.008	0.046	0.001	0.155	0.186
FY09	0.000	0.000	0.060	0.000	0.000	0.049	0.029	0.007	0.046	0.018	0.014	0.077

Table 72: 13S Career Field AAD Inventory by CYOS Using the 7-Year Option (Increasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	3	6	1	4	9	9	4	35
FY04	0	0	0	0	0	0	5	6	1	4	9	10	35
FY05	0	0	0	0	0	38	44	42	6	1	3	8	141
FY06	0	0	21	0	0	39	35	45	40	6	1	3	191
FY07	0	0	24	21	0	43	39	46	44	39	5	1	262
FY08	0	0	20	24	21	42	41	48	44	43	48	5	335
FY09	0	0	22	20	24	40	45	41	49	48	43	50	382

Table 73: 13S Career Field Educational Requirements by CYOS Using the 7-Year Option (Increasing Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	0	0	0	32	37	31	0	0	0	0	0	0	100
FY06	18	0	0	33	0	3	0	0	0	0	0	0	54
FY07	20	0	0	36	2	10	1	0	0	0	0	0	69
FY08	17	0	0	35	1	9	0	1	11	0	0	0	74
FY09	19	0	0	16	5	2	3	5	4	7	0	0	61

Table 74: 13S Career Field Entrance Transition Rates by CYOS Using the 7-Year Option (Increasing Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.000	0.000	0.000	0.134	0.168	0.158	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.077	0.000	0.000	0.126	0.000	0.017	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.077	0.000	0.000	0.126	0.008	0.048	0.002	0.000	0.000	0.000
FY08	0.000	0.000	0.060	0.000	0.000	0.112	0.000	0.039	0.000	0.000	0.066	0.000
FY09	0.000	0.000	0.060	0.000	0.000	0.049	0.015	0.007	0.011	0.022	0.019	0.039

Table 75: 13S Career Field AAD Inventory by CYOS Using the 4-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	3	6	1	4	9	9	4	35
FY04	0	0	0	0	0	0	5	6	1	4	9	10	35
FY05	0	0	11	0	0	24	23	25	6	1	3	8	102
FY06	0	0	11	11	0	21	23	22	25	23	22	26	184
FY07	0	0	11	11	11	21	23	22	25	24	22	26	196
FY08	0	0	11	11	11	21	23	22	25	24	22	26	196
FY09	0	0	11	11	11	21	23	22	25	24	22	26	196

Table 76: 13S Career Field Educational Requirements by CYOS Using the 4-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	12	0	0	24	23	21	0	0	0	0	0	0	80
FY06	12	0	0	21	1	0	1	18	21	23	0	0	97
FY07	12	0	0	21	4	0	5	1	1	7	0	0	51
FY08	12	0	0	10	4	0	5	0	0	7	0	0	38
FY09	12	0	0	10	4	0	5	0	0	7	0	0	38

Table 77: 13S Career Field Entrance Transition Rates by CYOS Using the 4-Year Option (Constant Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.060	0.000	0.000	0.114	0.116	0.120	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.060	0.000	0.000	0.098	0.001	0.000	0.002	0.130	0.165	0.184
FY07	0.000	0.000	0.060	0.000	0.000	0.098	0.019	0.000	0.029	0.001	0.001	0.063
FY08	0.000	0.000	0.060	0.000	0.000	0.047	0.019	0.000	0.029	0.000	0.000	0.063
FY09	0.000	0.000	0.060	0.000	0.000	0.047	0.019	0.000	0.029	0.000	0.000	0.060

Table 78: 13S Career Field AAD Inventory by CYOS Using the 5-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	3	6	1	4	9	9	4	35
FY04	0	0	0	0	0	0	5	6	1	4	9	10	35
FY05	0	0	13	0	0	23	23	5	6	1	3	8	82
FY06	0	0	11	13	0	24	22	26	25	6	1	3	131
FY07	0	0	11	11	13	21	23	21	25	24	22	26	197
FY08	0	0	11	11	11	21	23	22	25	24	22	26	196
FY09	0	0	11	11	11	21	23	22	25	24	22	26	196

Table 79: 13S Career Field Educational Requirements by CYOS Using the 5-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	14	0	0	24	23	0	0	0	0	0	0	0	61
FY06	12	0	0	24	1	4	21	0	0	0	0	0	62
FY07	12	0	0	21	1	0	1	0	17	26	0	0	78
FY08	12	0	0	8	4	0	5	0	0	7	0	0	36
FY09	12	0	0	10	4	0	5	0	0	7	0	0	38

Table 80: 13S Career Field Entrance Transition Rates by CYOS Using the 5-Year Option (Constant Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.069	0.000	0.000	0.111	0.116	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.060	0.000	0.000	0.114	0.001	0.025	0.129	0.000	0.000	0.000
FY07	0.000	0.000	0.060	0.000	0.000	0.098	0.002	0.000	0.002	0.000	0.133	0.198
FY08	0.000	0.000	0.060	0.000	0.000	0.038	0.019	0.000	0.033	0.000	0.000	0.062
FY09	0.000	0.000	0.060	0.000	0.000	0.047	0.019	0.000	0.029	0.000	0.000	0.060

Table 81: 13S Career Field AAD Inventory by CYOS Using the 6-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	3	6	1	4	9	9	4	35
FY04	0	0	0	0	0	0	5	6	1	4	9	10	35
FY05	0	0	13	0	0	24	0	5	6	1	3	8	60
FY06	0	0	13	13	0	23	23	26	4	6	1	3	113
FY07	0	0	11	13	13	23	22	26	25	4	5	1	144
FY08	0	0	12	11	13	20	23	21	25	24	21	26	197
FY09	0	0	11	12	11	21	23	22	25	24	22	26	197

Table 82: 13S Career Field Educational Requirements by CYOS Using the 6-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	14	0	0	25	0	0	0	0	0	0	0	0	39
FY06	14	0	0	24	1	26	0	0	0	0	0	0	65
FY07	12	0	0	24	1	4	0	0	0	0	0	0	41
FY08	12	0	0	8	2	0	1	0	18	22	0	0	63
FY09	12	0	0	8	4	0	5	0	0	8	0	0	37

Table 83: 13S Career Field Entrance Transition Rates by CYOS Using the 6-Year Option (Constant Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.069	0.000	0.000	0.115	0.000	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.069	0.000	0.000	0.111	0.002	0.144	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.060	0.000	0.000	0.111	0.003	0.024	0.000	0.000	0.000	0.000
FY08	0.000	0.000	0.062	0.000	0.000	0.037	0.007	0.000	0.004	0.000	0.141	0.172
FY09	0.000	0.000	0.060	0.000	0.000	0.038	0.021	0.000	0.031	0.000	0.000	0.065

Table 84: 13S Career Field AAD Inventory by CYOS Using the 7-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	3	6	0	3	9	8	4	6	39
FY03	0	0	0	0	0	3	6	1	4	9	9	4	35
FY04	0	0	0	0	0	0	5	6	1	4	9	10	35
FY05	0	0	0	0	0	24	27	26	6	1	3	8	95
FY06	0	0	13	0	0	24	27	26	25	6	1	3	124
FY07	0	0	13	13	0	23	23	26	25	24	5	1	153
FY08	0	0	11	13	13	24	22	26	25	24	22	5	184
FY09	0	0	11	11	13	21	23	21	25	24	22	27	198

Table 85: 13S Career Field Educational Requirements by CYOS Using the 7-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	0	0	0	25	27	22	0	0	0	0	0	0	74
FY06	14	0	0	25	5	1	0	0	0	0	0	0	45
FY07	14	0	0	24	1	0	1	0	0	0	0	0	40
FY08	12	0	0	24	1	5	0	0	0	0	0	0	42
FY09	12	0	0	8	1	0	1	0	0	9	0	0	31

Table 86: 13S Career Field Entrance Transition Rates by CYOS Using the 7-Year Option (Constant Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.000	0.000	0.000	0.115	0.137	0.121	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.069	0.000	0.000	0.114	0.025	0.001	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.069	0.000	0.000	0.111	0.001	0.000	0.000	0.000	0.000	0.000
FY08	0.000	0.000	0.060	0.000	0.000	0.111	0.001	0.027	0.000	0.000	0.000	0.000
FY09	0.000	0.000	0.060	0.000	0.000	0.038	0.004	0.000	0.000	0.000	0.000	0.075

Table 87: 13S Career Field AAD Inventory by CYOS Using the 8-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	0	3	6	1	4	9	9	4	35
FY03	0	0	0	0	0	0	5	6	1	4	9	10	35
FY04	0	0	0	0	0	24	22	5	6	1	3	8	69
FY05	0	0	0	0	0	24	23	21	4	6	1	3	82
FY06	0	0	0	0	0	23	23	26	25	4	5	1	107
FY07	0	0	11	0	0	22	22	24	25	24	4	5	137
FY08	0	0	12	11	0	21	22	26	25	24	22	3	166
FY09	0	0	11	12	11	21	23	21	25	24	22	26	196
FY10	0	0	11	11	12	21	23	22	25	24	22	26	196
FY11	0	0	11	11	11	21	23	22	25	24	22	26	196
FY12	0	0	0	0	0	3	6	1	4	9	9	4	35

Table 88: 13S Career Field Educational Requirements by CYOS Using the 8-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	0	0	0	0	0	25	22	0	0	0	0	0	47
FY06	0	0	0	0	0	25	0	1	0	0	0	0	26
FY07	0	0	0	0	0	24	0	5	5	0	0	0	34
FY08	0	0	12	0	0	23	1	3	1	0	0	0	40
FY09	0	0	12	0	0	21	2	5	2	0	0	0	42
FY10	0	0	12	0	0	21	4	0	1	0	0	7	45
FY11	0	0	12	0	0	10	4	0	5	0	0	7	38
FY12	0	0	12	0	0	10	4	0	5	0	0	7	38

Table 89: 13S Career Field Entrance Transition Rates by CYOS Using the 8-Year Option (Constant Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.000	0.000	0.000	0.114	0.112	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.000	0.000	0.000	0.115	0.000	0.003	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.000	0.000	0.000	0.109	0.000	0.027	0.030	0.000	0.000	0.000
FY08	0.000	0.000	0.060	0.000	0.000	0.105	0.002	0.015	0.001	0.000	0.000	0.000
FY09	0.000	0.000	0.061	0.000	0.000	0.099	0.008	0.031	0.012	0.000	0.000	0.000
FY10	0.000	0.000	0.060	0.000	0.000	0.098	0.018	0.000	0.001	0.000	0.000	0.061
FY11	0.000	0.000	0.060	0.000	0.000	0.047	0.019	0.000	0.033	0.000	0.000	0.061
FY12	0.000	0.000	0.060	0.000	0.000	0.046	0.019	0.000	0.029	0.000	0.000	0.061

Table 90: 13S Career Field AAD Inventory by CYOS Using the 9-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	0	3	6	1	4	9	9	4	35
FY03	0	0	0	0	0	0	5	6	1	4	9	10	35
FY04	0	0	11	0	0	24	0	5	6	1	3	8	59
FY05	0	0	11	11	0	24	23	0	4	6	1	3	84
FY06	0	0	11	11	11	24	23	22	0	4	5	1	113
FY07	0	0	12	11	11	21	23	25	21	0	4	5	132
FY08	0	0	11	12	11	22	22	24	25	20	0	3	151
FY09	0	0	12	11	12	23	22	26	25	24	18	0	173
FY10	0	0	12	12	11	22	22	21	25	24	22	26	196
FY11	0	0	11	12	12	21	23	21	25	24	22	26	196
FY12	0	0	0	0	0	3	6	1	4	9	9	4	35

Table 91: 13S Career Field Educational Requirements by CYOS Using the 9-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	0	0	12	0	0	25	0	0	0	0	0	0	37
FY06	0	0	12	0	0	25	0	0	0	0	0	0	37
FY07	0	0	12	0	0	25	0	0	0	0	0	0	37
FY08	0	0	12	0	0	10	0	4	0	0	0	0	26
FY09	0	0	12	0	0	11	3	3	1	0	0	0	30
FY10	0	0	12	0	0	12	2	5	2	0	0	0	33
FY11	0	0	12	0	0	10	1	0	1	0	0	10	34
FY12	0	0	12	0	0	10	3	0	5	0	0	7	37

Table 92: 13S Career Field Entrance Transition Rates by CYOS Using the 9-Year Option (Constant Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.060	0.000	0.000	0.115	0.000	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.060	0.000	0.000	0.115	0.000	0.000	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.060	0.000	0.000	0.115	0.000	0.000	0.000	0.000	0.000	0.000
FY08	0.000	0.000	0.062	0.000	0.000	0.047	0.000	0.020	0.000	0.000	0.000	0.000
FY09	0.000	0.000	0.060	0.000	0.000	0.054	0.014	0.017	0.007	0.000	0.000	0.000
FY10	0.000	0.000	0.062	0.000	0.000	0.060	0.008	0.030	0.010	0.000	0.000	0.000
FY11	0.000	0.000	0.063	0.000	0.000	0.049	0.001	0.000	0.001	0.000	0.000	0.087
FY12	0.000	0.000	0.060	0.000	0.000	0.047	0.015	0.000	0.033	0.000	0.000	0.061

Table 93: 13S Career Field AAD Inventory by CYOS Using the 10-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY02	0	0	0	0	0	3	6	1	4	9	9	4	35
FY03	0	0	0	0	0	0	5	6	1	4	9	10	35
FY04	0	0	11	0	0	24	0	5	6	1	3	8	59
FY05	0	0	11	11	0	24	23	0	4	6	1	3	84
FY06	0	0	11	11	11	24	23	22	0	4	5	1	113
FY07	0	0	13	11	11	24	23	26	25	0	4	5	141
FY08	0	0	12	13	11	21	22	25	25	24	0	3	156
FY09	0	0	12	12	13	22	22	26	25	24	22	0	179
FY10	0	0	11	12	12	24	23	26	25	24	22	19	198
FY11	0	0	11	11	12	21	23	21	30	24	22	26	202
FY12	0	0	0	0	0	3	6	1	4	9	9	4	35

Table 94: 13S Career Field Educational Requirements by CYOS Using the 10-Year Option (Constant Manpower)

	CYOS												
Fiscal Year	0	1	2	3	4	5	6	7	8	9	10	11	Total
FY05	0	0	12	0	0	25	0	0	0	0	0	0	37
FY06	0	0	12	0	0	25	0	0	0	0	0	0	37
FY07	0	0	12	0	0	25	0	0	0	0	0	0	37
FY08	0	0	13	0	0	13	0	5	4	0	0	0	35
FY09	0	0	12	0	0	10	0	4	0	0	0	0	26
FY10	0	0	13	0	0	12	4	5	1	0	0	0	35
FY11	0	0	12	0	0	12	2	5	0	0	0	0	31
FY12	0	0	12	0	0	9	1	0	5	0	0	7	34

Table 95: 13S Career Field Entrance Transition Rates by CYOS Using the 10-Year Option (Constant Manpower)

	CYOS											
	0	1	2	3	4	5	6	7	8	9	10	11
FY05	0.000	0.000	0.060	0.000	0.000	0.115	0.000	0.000	0.000	0.000	0.000	0.000
FY06	0.000	0.000	0.060	0.000	0.000	0.115	0.000	0.000	0.000	0.000	0.000	0.000
FY07	0.000	0.000	0.060	0.000	0.000	0.115	0.000	0.000	0.000	0.000	0.000	0.000
FY08	0.000	0.000	0.068	0.000	0.000	0.061	0.000	0.027	0.027	0.000	0.000	0.000
FY09	0.000	0.000	0.062	0.000	0.000	0.047	0.000	0.020	0.000	0.000	0.000	0.000
FY10	0.000	0.000	0.065	0.000	0.000	0.056	0.017	0.031	0.006	0.000	0.000	0.000
FY11	0.000	0.000	0.060	0.000	0.000	0.056	0.008	0.029	0.000	0.000	0.000	0.000
FY12	0.000	0.000	0.060	0.000	0.000	0.045	0.001	0.000	0.035	0.000	0.000	0.061

Appendix E: VBA Code for AADIM-E

```
Private Sub Optimizing_Click()

‘The following code executes the one of the 4 options that optimizes the entrance rates for the
‘CYOS groups in a given fiscal year in Microsoft Excel.

'Reset the entrance transition rates for all fiscal years to 0
Range("F42:Q46").Value = 0

'Reset the textboxes that display the necessary graduate education requirements
Forecastsize1.Value = 0
Forecastsize2.Value = 0
Forecastsize3.Value = 0
Forecastsize4.Value = 0
Forecastsize5.Value = 0

'Execute the 4 year option code
If FourYrcheck = True Then
   Call fouryr_plan
End If

'Execute the 5 year option code
If FiveYrcheck = True Then
   Call fiveyr_plan
End If

'Execute the 6 year option code
If SixYrcheck = True Then
   Call sixyr_plan
End If

'Execute the 7 year option code
If SevenYrcheck = True Then
   Call sevenyr_plan
End If

'Update the textboxes that display the necessary graduate education requirements
Forecastsize1.Value = Range("R74").Value
Forecastsize2.Value = Range("R75").Value
Forecastsize3.Value = Range("R76").Value
Forecastsize4.Value = Range("R77").Value
Forecastsize5.Value = Range("R78").Value

End Sub
```

```
'The following sub programs execute a solver routine that maximizes the entrance transition
'rate for a specific CYOS group. Each solver routine has 2 constraints.  The first constraint
'states that the entrance rates are less than or equal to 1 and the second constraints states that
'the entrance transition rates are greater than or equal to 0.  Note that each solver routine can
'possibly maximize all or subset of the CYOS groups.

Sub fouryr_plan()

'Optimizes the option:  4 Year Plan
'       first fiscal year - optimizes 2, 5, 6, 7 CYOS groups
'       second fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       third fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       fourth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       fifth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups

If TwoYrRelease = False Then
   SOLVERReset
   solverOk setcell:=Range("S100"), MaxMinVal:=2, Bychange:=Union(Range("H42"),
Range("K42:m42"))
   solveradd cellref:=Range("F42:Q42"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F42:Q42"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S100"), MaxMinVal:=2, Bychange:=Union(Range("H43"),
Range("K43:q43"))
   solveradd cellref:=Range("F43:Q43"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F43:Q43"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("R44"), MaxMinVal:=2, Bychange:=Union(Range("H44"),
Range("K44:q44"))
   solveradd cellref:=Range("F44:Q44"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F44:Q44"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("R45"), MaxMinVal:=2, Bychange:=Union(Range("H45"),
Range("K45:q45"))
   solveradd cellref:=Range("F45:Q45"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F45:Q45"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("R46"), MaxMinVal:=2, Bychange:=Union(Range("H46"),
Range("K46:q46"))
   solveradd cellref:=Range("F46:Q46"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F46:Q46"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True
Else
```

```
'Optimizes the option:  4 Year Plan with 2 CYOS release option
'       first fiscal year - optimizes 2, 4, 5, 6, 7 CYOS groups
'       second fiscal year - optimizes 2, 4, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       third fiscal year - optimizes 2, 4, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       fourth fiscal year - optimizes 2, 4, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       fifth fiscal year - optimizes 2, 4, 5, 6, 7, 8, 9, 10, 11 CYOS groups

   SOLVERReset
   solverOk setcell:=Range("S100"), MaxMinVal:=2, Bychange:=Union(Range("H42"),
Range("j42:m42"))
   solveradd cellref:=Range("F42:Q42"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F42:Q42"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S100"), MaxMinVal:=2, Bychange:=Union(Range("H43"),
Range("j43:q43"))
   solveradd cellref:=Range("F43:Q43"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F43:Q43"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("R44"), MaxMinVal:=2, Bychange:=Union(Range("H44"),
Range("j44:q44"))
   solveradd cellref:=Range("F44:Q44"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F44:Q44"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("R45"), MaxMinVal:=2, Bychange:=Union(Range("H45"),
Range("j45:q45"))
   solveradd cellref:=Range("F45:Q45"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F45:Q45"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("R46"), MaxMinVal:=2, Bychange:=Union(Range("H46"),
Range("j46:q46"))
   solveradd cellref:=Range("F46:Q46"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F46:Q46"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True
End If

End Sub
```

```
Sub fiveyr_plan()

'Optimizes the option:  5 Year Plan
'       first fiscal year - optimizes 2, 5, 6 CYOS groups
'       second fiscal year - optimizes 2, 5, 6, 7, 8 CYOS groups
'       third fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       fourth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       fifth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups


If TwoYrRelease = False Then
   SOLVERReset
   solverOk setcell:=Range("S101"), MaxMinVal:=2, Bychange:=Union(Range("H42"),
Range("K42:l42"))
   solveradd cellref:=Range("F42:Q42"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F42:Q42"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S101"), MaxMinVal:=2, Bychange:=Union(Range("H43"),
Range("K43:n43"))
   solveradd cellref:=Range("F43:Q43"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F43:Q43"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S101"), MaxMinVal:=2, Bychange:=Union(Range("H44"),
Range("K44:q44"))
   solveradd cellref:=Range("F44:Q44"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F44:Q44"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("R45"), MaxMinVal:=2, Bychange:=Union(Range("H45"),
Range("K45:q45"))
   solveradd cellref:=Range("F45:Q45"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F45:Q45"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("R46"), MaxMinVal:=2, Bychange:=Union(Range("H46"),
Range("K46:q46"))
   solveradd cellref:=Range("F46:Q46"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F46:Q46"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True
Else

'Optimizes the option:  5 Year Plan with 2 CYOS release option
'       first fiscal year - optimizes 2, 4, 5, 6 CYOS groups
'       second fiscal year - optimizes 2, 4, 5, 6, 7, 8 CYOS groups
'       third fiscal year - optimizes 2, 4, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       fourth fiscal year - optimizes 2, 4, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       fifth fiscal year - optimizes 2, 4, 5, 6, 7, 8, 9, 10, 11 CYOS groups

   SOLVERReset
   solverOk setcell:=Range("S101"), MaxMinVal:=2, Bychange:=Range("j42:l42")
```

```
    solveradd cellref:=Range("F42:Q42"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F42:Q42"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("S101"), MaxMinVal:=2, Bychange:=Union(Range("H43"),
Range("j43:n43"))
    solveradd cellref:=Range("F43:Q43"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F43:Q43"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("S101"), MaxMinVal:=2, Bychange:=Union(Range("H44"),
Range("j44:q44"))
    solveradd cellref:=Range("F44:Q44"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F44:Q44"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("R45"), MaxMinVal:=2, Bychange:=Union(Range("H45"),
Range("j45:q45"))
    solveradd cellref:=Range("F45:Q45"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F45:Q45"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("R46"), MaxMinVal:=2, Bychange:=Union(Range("H46"),
Range("j46:q46"))
    solveradd cellref:=Range("F46:Q46"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F46:Q46"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True
End If

End Sub
```

```
Sub sixyr_plan()

'Optimizes the option:  6 Year Plan
'       first fiscal year - optimizes 2, 5 CYOS groups
'       second fiscal year - optimizes 2, 5, 6, 7 CYOS groups
'       third fiscal year - optimizes 2, 5, 6, 7, 8 CYOS groups
'       fourth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       fifth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups


If TwoYrRelease = False Then
   SOLVERReset
   solverOk setcell:=Range("S102"), MaxMinVal:=2, Bychange:=Union(Range("H42"),
Range("K42"))
   solveradd cellref:=Range("F42:Q42"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F42:Q42"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S102"), MaxMinVal:=2, Bychange:=Union(Range("H43"),
Range("K43:m43"))
   solveradd cellref:=Range("F43:Q43"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F43:Q43"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S102"), MaxMinVal:=2, Bychange:=Union(Range("H44"),
Range("K44:n44"))
   solveradd cellref:=Range("F44:Q44"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F44:Q44"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S102"), MaxMinVal:=2, Bychange:=Union(Range("H45"),
Range("K45:q45"))
   solveradd cellref:=Range("F45:Q45"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F45:Q45"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("R46"), MaxMinVal:=2, Bychange:=Union(Range("H46"),
Range("K46:q46"))
   solveradd cellref:=Range("F46:Q46"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F46:Q46"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True
Else

'Optimizes the option:  6 Year Plan with 2 CYOS release option
'       first fiscal year - optimizes 2, 4 CYOS groups
'       second fiscal year - optimizes 2, 4, 5 CYOS groups
'       third fiscal year - optimizes 2, 4, 5, 6, 7 CYOS groups
'       fourth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       fifth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups

   SOLVERReset
```

```
   solverOk setcell:=Range("S102"), MaxMinVal:=2, Bychange:=Union(Range("H42"),
Range("j42"))
   solveradd cellref:=Range("F42:Q42"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F42:Q42"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S102"), MaxMinVal:=2, Bychange:=Union(Range("H43"),
Range("j43:k43"))
   solveradd cellref:=Range("F43:Q43"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F43:Q43"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S102"), MaxMinVal:=2, Bychange:=Union(Range("H44"),
Range("j44:m44"))
   solveradd cellref:=Range("F44:Q44"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F44:Q44"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S102"), MaxMinVal:=2, Bychange:=Union(Range("H45"),
Range("j45:q45"))
   solveradd cellref:=Range("F45:Q45"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F45:Q45"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("R46"), MaxMinVal:=2, Bychange:=Union(Range("H46"),
Range("j46:q46"))
   solveradd cellref:=Range("F46:Q46"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F46:Q46"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True
End If

End Sub
```

```
Sub sevenyr_plan()

'Optimizes the option:  7 Year Plan
'       first fiscal year - optimizes 5, 6, 7 CYOS groups
'       second fiscal year - optimizes 2, 5, 6, 7 CYOS groups
'       third fiscal year - optimizes 2, 5, 6, 7, 8 CYOS groups
'       fourth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10 CYOS groups
'       fifth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups

If TwoYrRelease = False Then
   SOLVERReset
   solverOk setcell:=Range("S103"), MaxMinVal:=2, Bychange:=Range("K42:m42")
   solveradd cellref:=Range("F42:Q42"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F42:Q42"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S103"), MaxMinVal:=2, Bychange:=Union(Range("H43"),
Range("K43:m43"))
   solveradd cellref:=Range("F43:Q43"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F43:Q43"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S103"), MaxMinVal:=2, Bychange:=Union(Range("H44"),
Range("K44:n44"))
   solveradd cellref:=Range("F44:Q44"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F44:Q44"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S103"), MaxMinVal:=2, Bychange:=Union(Range("H45"),
Range("K45:p45"))
   solveradd cellref:=Range("F45:Q45"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F45:Q45"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S103"), MaxMinVal:=2, Bychange:=Union(Range("H46"),
Range("K46:q46"))
   solveradd cellref:=Range("F46:Q46"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F46:Q46"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True
Else

'Optimizes the option:  7 Year Plan with 2 CYOS release option
'       first fiscal year - optimizes 4, 5 CYOS groups
'       second fiscal year - optimizes 2, 4, 5, 6 CYOS groups
'       third fiscal year - optimizes 2, 4, 5, 6 CYOS groups
'       fourth fiscal year - optimizes 2, 5, 6, 7, 8, 9 CYOS groups
'       fifth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups

SOLVERReset
   solverOk setcell:=Range("S103"), MaxMinVal:=2, Bychange:=Range("J42:K42")
   solveradd cellref:=Range("F42:Q42"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F42:Q42"), Relation:=3, Formulatext:="0"
```

```
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("S103"), MaxMinVal:=2, Bychange:=Union(Range("H43"),
Range("J43:L43"))
    solveradd cellref:=Range("F43:Q43"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F43:Q43"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("S103"), MaxMinVal:=2, Bychange:=Union(Range("H44"),
Range("J44:L44"))
    solveradd cellref:=Range("F44:Q44"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F44:Q44"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("S103"), MaxMinVal:=2, Bychange:=Union(Range("H45"),
Range("J45:o45"))
    solveradd cellref:=Range("F45:Q45"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F45:Q45"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("S103"), MaxMinVal:=2, Bychange:=Union(Range("H46"),
Range("J46:q46"))
    solveradd cellref:=Range("F46:Q46"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F46:Q46"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True
End If

End Sub
```

```
Private Sub Optimize_further_Click()
'The following code executes the one of the 3 options that optimizes the entrance rates for the
'CYOS groups in a given fiscal year

'Reset the entrance transition rates for all fiscal years to 0
Range("F56:Q63").Value = 0

'Reset the textboxes that display the necessary graduate education requirements
Forecastsize1.Value = 0
Forecastsize2.Value = 0
Forecastsize3.Value = 0
Forecastsize4.Value = 0
Forecastsize5.Value = 0
Forecastsize6.Value = 0
Forecastsize7.Value = 0
Forecastsize8.Value = 0

'Execute the 8 year option code
If EightYrcheck = True Then
   Call eightyr_plan
End If

'Execute the 9 year option code
If NineYrcheck = True Then
   Call nineyr_plan
End If

'Execute the 10 year option code
If TenYrcheck = True Then
   Call tenyr_plan
End If

'Update the textboxes that display the necessary graduate education requirements
Forecastsize1.Value = Range("R94").Value
Forecastsize2.Value = Range("R95").Value
Forecastsize3.Value = Range("R96").Value
Forecastsize4.Value = Range("R97").Value
Forecastsize5.Value = Range("R98").Value
Forecastsize6.Value = Range("R99").Value
Forecastsize7.Value = Range("R100").Value
Forecastsize8.Value = Range("R101").Value
End Sub
```

```
Sub eightyr_plan()

'Optimizes the option:  8 Year Plan
'       first fiscal year - optimizes 5, 6 CYOS groups
'       second fiscal year - optimizes 5, 6, 7 CYOS groups
'       third fiscal year - optimizes 5, 6, 7, 8 CYOS groups
'       fourth fiscal year - optimizes 2, 5, 6, 7, 8, 9 CYOS groups
'       fifth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10 CYOS groups
'       sixth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       seventh fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       eighth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups

   SOLVERReset
   solverOk setcell:=Range("S129"), MaxMinVal:=2, Bychange:=Range("K56:L56")
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S130"), MaxMinVal:=2, Bychange:=Range("K57:m57")
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S131"), MaxMinVal:=2, Bychange:=Range("K58:n58")
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S132"), MaxMinVal:=2, Bychange:=Union(Range("H59"),
Range("K59:o59"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S133"), MaxMinVal:=2, Bychange:=Union(Range("H60"),
Range("K60:P60"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S133"), MaxMinVal:=2, Bychange:=Union(Range("H61"),
Range("K61:q61"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S134"), MaxMinVal:=2, Bychange:=Union(Range("H62"),
Range("K62:q62"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
```

```
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("S135"), MaxMinVal:=2, Bychange:=Union(Range("H63"),
Range("K63:q63"))
    solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

End Sub
```

```
Sub nineyr_plan()

'Optimizes the option:  9 Year Plan
'       first fiscal year - optimizes 2, 5 CYOS groups
'       second fiscal year - optimizes 2, 5 CYOS groups
'       third fiscal year - optimizes 2, 5, 6 CYOS groups
'       fourth fiscal year - optimizes 2, 5, 6, 7 CYOS groups
'       fifth fiscal year - optimizes 2, 5, 6, 7, 8 CYOS groups
'       sixth fiscal year - optimizes 2, 5, 6, 7, 8, 9 CYOS groups
'       seventh fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups
'       eighth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups

   SOLVERReset
   solverOk setcell:=Range("S129"), MaxMinVal:=2, Bychange:=Union(Range("H56"),
Range("K56"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S130"), MaxMinVal:=2, Bychange:=Union(Range("H57"),
Range("K57"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S131"), MaxMinVal:=2, Bychange:=Union(Range("H58"),
Range("K58:L58"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S132"), MaxMinVal:=2, Bychange:=Union(Range("H59"),
Range("K59:M59"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S133"), MaxMinVal:=2, Bychange:=Union(Range("H60"),
Range("K60:N60"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S134"), MaxMinVal:=2, Bychange:=Union(Range("H61"),
Range("K61:O61"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
```

```
    solverOk setcell:=Range("S135"), MaxMinVal:=2, Bychange:=Union(Range("H62"),
Range("K62:Q62"))
    solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("S135"), MaxMinVal:=2, Bychange:=Union(Range("H63"),
Range("K63:Q63"))
    solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True
End Sub
```

```
Sub tenyr_plan()

'Optimizes the option:  10 Year Plan
'       first fiscal year - optimizes 2, 5 CYOS groups
'       second fiscal year - optimizes 2, 5 CYOS groups
'       third fiscal year - optimizes 2, 5, 6 CYOS groups
'       fourth fiscal year - optimizes 2, 5, 6, 7, 8 CYOS groups
'       fifth fiscal year - optimizes 2, 5, 6, 7, 8, 9 CYOS groups
'       sixth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10 CYOS groups
'       seventh fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10 CYOS groups
'       eighth fiscal year - optimizes 2, 5, 6, 7, 8, 9, 10, 11 CYOS groups

   SOLVERReset
   solverOk setcell:=Range("S129"), MaxMinVal:=2, Bychange:=Union(Range("H56"),
Range("K56"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S130"), MaxMinVal:=2, Bychange:=Union(Range("H57"),
Range("K57"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S131"), MaxMinVal:=2, Bychange:=Union(Range("H58"),
Range("K58:L58"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S132"), MaxMinVal:=2, Bychange:=Union(Range("H59"),
Range("K59:N59"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S133"), MaxMinVal:=2, Bychange:=Union(Range("H60"),
Range("K60:O60"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
   solverOk setcell:=Range("S134"), MaxMinVal:=2, Bychange:=Union(Range("H61"),
Range("K61:P61"))
   solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
   solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
   SolverSolve UserFinish:=True

   SOLVERReset
```

```
    solverOk setcell:=Range("S135"), MaxMinVal:=2, Bychange:=Union(Range("H62"),
Range("K62:P62"))
    solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

    SOLVERReset
    solverOk setcell:=Range("S135"), MaxMinVal:=2, Bychange:=Union(Range("H63"),
Range("K63:q63"))
    solveradd cellref:=Range("F56:Q63"), Relation:=1, Formulatext:="1"
    solveradd cellref:=Range("F56:Q63"), Relation:=3, Formulatext:="0"
    SolverSolve UserFinish:=True

End Sub
```

Appendix F: Notional Officer and Assignment Data for AADIM-U

Notional Officer Data

We construct the notional officer data set for the 61S career field by first determining the percentage of officers with a related AAD by grade. For fiscal year 2004, we use the AFPC/DPSAA data set to calculate the percentage of officers with a related AAD degree as shown in Table 98. We then determine the percentage of officers with a related AAD who have an Academic Specialty Code of 0YEY and 0YSY as seen in Table 99.

Table 96: Percentage of Officers with a Related AAD for Officer Data

Rank	Percentage of officers an AAD
LT	9%
Captain	58%
Major	34%

Due to lack of available information we construct notional representative percentages as shown in Table 99 for Security Clearance, Experience and Training Levels. For Security Clearance, we assume that all LTs have a secret clearance and expect to see the percentage of top secret (TS) clearances to increase as the grade increases from Captain to Major. We then apply a similar methodology for the Experience and Training Levels as the Security Clearance. We assume that all the LTs meet the desired experience and training levels for all LT assignments and then as officers progress through each grade, we expect officers to become more specialized and therefore fewer officers will meet the experience and training levels for each given assignment.

Table 97: Attribute Percentage Levels by Grade for Officer Data

Desired Requirement	Level	LT	Captain	Major
Academic Specialty Code	0YEY	100%	94%	97%
	0YSY	0%	6%	3%
Security Clearance	S	100%	75%	65%
	TS	0%	25%	35%
Experience Level	Desired Requirements Met	100%	80%	65%
	Desired Requirements Not Met	0%	20%	35%
Training Level	Desired Requirements Met	100%	80%	65%
	Desired Requirements Not Met	0%	20%	35%

For the Officer Preferences attribute, we randomly select five of the 50 assignments available from the assignment list for each officer as their duty preferences. We also assume each officer equally prefers all five assignments.

We interviewed a 61S Development Team member to determine the typical DT Vector level percentages by grade shown in Table 100 (15:1).

Table 98: DT Vector Level Percentages by Grade for Officer Data

DT Vector Level	LT	Captain	Major
JCS	0.0%	0.0%	5.0%
Air Staff	0.0%	0.0%	7.3%
Joint Other	0.0%	0.0%	7.3%
MAJCOM Staff	0.0%	0.0%	7.3%
FOA/DRU	5.0%	10.0%	7.3%
NAF/SPO/Center	30.0%	25.0%	7.3%
AF-level Instructor Duty	0.0%	5.0%	7.3%
Wing/Base Duty	10.0%	10.0%	7.3%
Deputy Group Commander	0.0%	0.0%	0.0%
Squadron Commander	0.0%	0.0%	5.0%
Operational Assignments	40.0%	25.0%	5.0%
Developmental Assignment	0.0%	0.0%	7.3%
Political-Military/FAO	0.0%	0.0%	5.0%
Developmental Education	0.0%	5.0%	7.3%
Crossflow (permanently change Core AFSC)	0.0%	0.0%	7.3%
Needs of the Air Force	15.0%	10.0%	7.3%

Notional Assignment Data

We construct the notional assignment data from a listing of billets Air Force wide that require an AAD (8:1). We determine the billets that are for a Major and below and require either a 0YEY or 0YSY Academic Specialty Code. Security Clearance data for assignment data is not available. We then use notional percentages shown in Table 101 for the assignment data. We assume that all assignments for LTs desire only a secret clearance. For Captain and Majors, we assume that 70% of assignments desire a secret clearance and 10% desire a TS clearance. The final 20% of assignments require an officer to have a TS clearance to be eligible for the assignment.

Table 99: Attribute Percentage Levels by Grade for Assignment Data

Officer	Level	LT	Captain	Major
Security Clearance	S	100%	70%	70%
	TS (Desirable)	0%	10%	10%
	TS (Required)	0%	20%	20%

The billet listing specifies a MAJCOM for each assignment (8:1) and for which we are able to assign a duty type that corresponds to the DT Vector level in the notional officer data as seen in Table 102. Note that Joint Command and MAJCOM Staff duty types have a specific grade requirement.

Table 100: Duty Type Percentages for Assignment Data

MAJCOM	Duty Type	Grade	Percentage
AF Center for Studies & Analysis	FOA/DRU	All	100%
AF Personnel Operations Agency	FOA/DRU	All	100%
AFELM Defense Intelligence Agency	FOA/DRU	Major	100%
AFELM Defense Logistics Agency	FOA/DRU	All	100%
AFELM US Central Command	Joint Other	Major	100%
AFELM US Joint Forces Command	Joint Other	Major	100%
AFELM USSTRATCOM.	Joint Other	Major	100%
AFELM USTRANSCOM	Joint Other	Major	100%
Air Combat Command	MAJCOM Staff	Major	27%
	NAF/SPO/Center	All	45%
	Operational assignment	All	27%
Air Education and Training Command	FOA/DRU	All	25%
	MAJCOM Staff	Major	17%
	NAF/SPO/Center	All	33%
	Operational assignment	All	25%
Air Force Intelligence Agency	FOA/DRU	All	100%
Air Force Logistics Management Agency	FOA/DRU	All	100%
Air Force Materiel Command	MAJCOM Staff	Major	17%
	NAF/SPO/Center	All	83%
Air Force Operational Test and Evaluation Agency	FOA/DRU	All	100%
Air Force Personnel Center	FOA/DRU	All	100%
Air Mobility Command	MAJCOM Staff	Major	40%
	NAF/SPO/Center	All	60%
Defense Threat Reduction Agency	FOA/DRU	All	100%
Headquarters US Air Force	Air Staff	Major	100%
HQ Air Force Space Command	MAJCOM Staff	Major	17%
	NAF/SPO/Center	All	67%
	Operational assignment	All	17%
US Air Force Academy	FOA/DRU	All	100%
US Air Forces Europe	MAJCOM Staff	Major	100%

Appendix G: Decision Maker 1 Interview Summary for 7-Attribute Case

Seven different criteria shown below are desirable qualifications an officer might possess. These qualifications determine a "goodness of fit" between an assignment and a potential officer. We can assign a 1 or 0 for each desirable qualification an officer meets for each assignment. Although, we do not assume that each desirable qualification is important as another. So, we wish to develop a relative weighting scheme to apply to each criteria.

To determine the weighting scheme, we use the following method:

Step 1: Order the alternatives in order of importance from highest to lowest. Once finished, press the button below.

	Order
Security Clearance	1
Training Level	1
Academic Specialty Code	2
Experience Level	2
DT Vector	3
Officer Preferences	3
Grade	4

Rank Order Finished?

Step 2: Next, seven sets of two alternatives, Alternative A and Alternative B are presented.

The first alternative has one criteria set at its most preferred level and all other criteria set at their least preferred level (i.e., An officer meets one only desirable qualification). The second alternative has different criteria set at its most preferred level and all other criteria set at their least preferred levels.

As the decision maker, how important is **Alternative A** compared to **Alternative B** (i.e. is Alternative A 2 time more important than Alternative B or is Alternative B 3 times more important than Alternative A)?

		Most Preferred Attribute	Relative Importance Factor
Set 1	Alternative A	Security Clearance	1.00
	Alternative B	Training Level	
Set 2	Alternative A	Training Level	2.00
	Alternative B	Academic Specialty Code	
Set 3	Alternative A	Academic Specialty Code	1.00
	Alternative B	Experience Level	
Set 4	Alternative A	Experience Level	1.50
	Alternative B	DT Vector	
Set 5	Alternative A	DT Vector	1.00
	Alternative B	Officer Preferences	
Set 6	Alternative A	Officer Preferences	2.00
	Alternative B	Grade	

Appendix H: Decision Maker 2 Interview Summary for 7-Attribute Case

Seven different criteria shown below are desirable qualifications an officer might possess. These qualifications determine a "goodness of fit" between an assignment and a potential officer. We can assign a 1 or 0 for each desirable qualification an officer meets for each assignment. Although, we do not assume that each desirable qualification is important as another. So, we wish to develop a relative weighting scheme to apply to each criteria.

To determine the weighting scheme, we use the following method:

Step 1: Order the alternatives in order of importance from highest to lowest. Once finished, press the button below.

	Order
Academic Specialty Code	1
Security Clearance	2
DT Vector	3
Officer Preferences	4
Experience Level	6
Training Level	5
Grade	7

Rank Order Finished?

Step 2: Next, seven sets of two alternatives, Alternative A and Alternative B are presented.

The first alternative has one criteria set at its most preferred level and all other criteria set at their least preferred level (i.e., An officer meets one only desirable qualification). The second alternative has different criteria set at its most preferred level and all other criteria set at their least preferred levels.

As the decision maker, how important is **Alternative A** compared to **Alternative B** (i.e. is Alternative A 2 time more important than Alternative B or is Alternative B 3 times more important than Alternative A)?

		Most Preferred Attribute	Relative Importance Factor
Set 1	Alternative A	Academic Specialty Code	2.00
	Alternative B	Security Clearance	
Set 2	Alternative A	Security Clearance	2.00
	Alternative B	DT Vector	
Set 3	Alternative A	DT Vector	2.00
	Alternative B	Officer Preferences	
Set 4	Alternative A	Officer Preferences	2.00
	Alternative B	Experience Level	
Set 5	Alternative A	Experience Level	2.00
	Alternative B	Training Level	
Set 6	Alternative A	Training Level	2.00
	Alternative B	Grade	

Appendix I: AADIM-U Results for 7-Attribute Case

Tables 101 – 104 show the individual assignment pairings for each decision maker in the seven-attribute case. Tables 105 – 108 show the average absolute difference from the baseline and average identical assignment matching for each decision maker in the seven-attribute case

Table 101: AADIM-U Results for Data Set 1

	Decision Maker 1		Decision Maker 2	
Officer	Assignment	Value Score	Assignment	Value Score
1	job28	0.874	job28	0.913
2	job25	0.606	job25	0.391
3	job19	0.598	job19	0.348
4	job34	0.874	job34	0.913
5	job31	0.37	job31	0.783
6	job16	0.307	job42	0.913
7	job2	0.906	job36	0.522
8	job44	0	job30	0.783
9	job32	1	job32	1
10	job15	0.874	job15	0.913
11	job42	0.843	job2	0.783
12	job5	0.969	job5	0.87
13	job1	0.677	job1	0.609
14	job37	0.843	job20	0.783
15	job40	0.874	job40	0.913
16	job4	0.433	job4	0.783
17	job23	0.921	job39	0.652
18	job27	0.858	job27	0.652
19	job30	0.858	job44	0
20	job41	0.606	job50	0.391
21	job43	0.48	job43	0.609
22	job50	0.528	job41	0.435
23	job47	0	job47	0
24	job39	0.866	job37	0.913
25	job9	0	job9	0
26	job49	0.843	job49	0.783
27	job18	0.654	job18	0.522
28	job20	0.858	job12	0
29	job17	0.614	job17	0.609
30	job36	0.614	job48	0.957
31	job11	0.669	job11	0.391
32	job6	1	job6	1
33	job35	0.575	job35	0.261
34	job38	0.622	job38	0.652
35	job3	0.685	job3	0.652

36	job33	0.622	job13	0.696
37	job48	1	job16	0.696
38	job45	0.37	job45	0.783
39	job14	0.488	job14	0.826
40	job24	0.835	job24	0.739
41	job46	0.866	job46	0.87
42	job26	1	job26	1
43	job7	0.969	job7	0.87
44	job8	0.559	job8	0.565
45	job12	0	job33	0.652
46	job10	0.496	job10	0.87
47	job22	0.937	job22	0.913
48	job13	0.307	job23	0.826
49	job29	0.858	job29	0.652
50	job21	0.496	job21	0.87
Total		33.102		33.527

Table 102: AADIM-U Results for Data Set 2

	Decision Maker 1		Decision Maker 2	
Officer	Assignment	Value Score	Assignment	Value Score
1	job46	0.522	job38	0.89
2	job44	0.652	job3	0.685
3	job29	1	job32	1
4	job6	0.435	job44	0.559
5	job27	0.87	job27	0.969
6	job30	0.522	job46	0.764
7	job5	0.913	job5	0.874
8	job24	0.826	job20	0.811
9	job12	0.435	job24	0
10	job33	0.696	job7	0.937
11	job34	0	job33	0
12	job14	0.652	job2	0.559
13	job19	0.957	job19	0.992
14	job1	0.522	job1	0.591
15	job48	0.826	job47	0.307
16	job43	0.609	job43	0.717
17	job45	0.522	job14	0.606
18	job23	0.913	job23	0.874
19	job11	0.391	job11	0.669
20	job4	0.696	job26	0.811
21	job31	0.826	job15	0.874
22	job13	0.87	job13	0.496
23	job17	0.826	job39	0.866
24	job40	0.913	job40	0.874
25	job49	0.609	job6	0.528
26	job3	0.435	job45	0
27	job37	1	job37	1
28	job10	0.913	job10	0.874
29	job18	0.565	job18	0.559

30	job21	0.652	job21	0.858
31	job38	0.913	job34	0.622
32	job22	0.565	job22	0.559
33	job2	0	job4	0.26
34	job32	0.652	job50	0.858
35	job20	0.783	job31	0.811
36	job28	0.826	job28	0.811
37	job16	0.913	job16	0.937
38	job41	0.565	job41	0.559
39	job25	0.783	job25	0.37
40	job7	0.913	job30	0.937
41	job9	0.739	job9	0.748
42	job47	0.696	job48	0.811
43	job15	0.652	job42	0.795
44	job39	0.87	job17	0.811
45	job8	0.652	job8	0.339
46	job26	0.826	job49	0.433
47	job50	0	job12	0.606
48	job42	0.565	job29	0.795
49	job35	0.913	job35	0.874
50	job36	0.913	job36	0.874
Total		34.307		34.354

Table 103: AADIM-U Results for Data Set 3

	Decision Maker 1		Decision Maker 2	
Officer	Assignment	Value Score	Assignment	Value Score
1	job45	0.9135	job15	0.9921
2	job26	0.8695	job5	0.9371
3	job7	0.6525	job37	0.4171
4	job44	0.9135	job44	0.8741
5	job23	0.9135	job23	0.8741
6	job24	0.5655	job7	0.7951
7	job17	0.6085	job17	0.3311
8	job31	0.6525	job31	0.6221
9	job22	0.4785	job22	0.1101
10	job38	0.7825	job38	0.9051
11	job12	0.6525	job12	0.6851
12	job40	0.7825	job40	0.8421
13	job41	0.9565	job41	0.9921
14	job6	0.8265	job6	0.9611
15	job48	0.9135	job48	0.8741
16	job28	0.3915	job28	0.3231
17	job32	0.7825	job32	0.8421
18	job8	0.6525	job8	0.8581
19	job33	0.9135	job33	0.9371
20	job20	0.4345	job14	0.0551
21	job4	0.8695	job4	0.8661
22	job1	0.6525	job1	0.6851
23	job49	0.4785	job16	0.6381

24	job25	0.9135	job26	0.8661
25	job35	0.9565	job45	0.8111
26	job21	0.7825	job21	0.8421
27	job37	0.4785	job24	0.8501
28	job3	0.6085	job3	0.6141
29	job18	0.6525	job18	0.6221
30	job2	0.8695	job2	0.8661
31	job47	0.9135	job47	0.9371
32	job14	0.2605	job20	0.5351
33	job39	0.7395	job39	0.7481
34	job43	0.8695	job43	0.8661
35	job30	0.6525	job30	0.4011
36	job19	0.9135	job19	0.8741
37	job9	0.8265	job9	0.4881
38	job11	0.6525	job11	0.6851
39	job15	0.9135	job35	0.9371
40	job34	0.9135	job34	0.9371
41	job29	0.5655	job29	0.5591
42	job46	0.6525	job50	0.8741
43	job16	0.6525	job49	0.8661
44	job27	0.6525	job27	0.6221
45	job50	0.9135	job25	0.8741
46	job13	0.6525	job13	0.8581
47	job5	0.9135	job46	0.6221
48	job10	0.6525	job10	0.9211
49	job36	0.9565	job36	0.9921
50	job42	0.8695	job42	0.8661
Total		37.054		37.353

Table 104: AADIM-U Results for Data Set 4

	Decision Maker 1		Decision Maker 2	
Officer	Assignment	Value Score	Assignment	Value Score
1	job31	0.87	job50	0.929
2	job30	0.913	job30	0.874
3	job45	0.783	job49	0.906
4	job49	0.783	job47	0.402
5	job36	0.739	job36	0.465
6	job7	0.609	job7	0.244
7	job12	0.783	job12	0.37
8	job34	0.652	job34	0.622
9	job47	0.261	job48	0.669
10	job13	0.87	job13	0.866
11	job2	0.783	job44	0.402
12	job40	0.913	job8	0.362
13	job29	0.739	job2	0.906
14	job50	0.957	job40	0.992
15	job28	0.87	job29	0.866
16	job41	0.652	job41	0.339
17	job11	0.739	job11	0.362

18	job39	0.609	job39	0.717
19	job6	0.783	job6	0.906
20	job32	1	job32	1
21	job37	0.87	job37	0.866
22	job19	0.652	job19	0.622
23	job10	0.913	job10	0.874
24	job38	0.652	job38	0.858
25	job43	1	job43	1
26	job21	0.87	job21	0.866
27	job46	0.652	job46	0.622
28	job22	1	job22	1
29	job4	0.565	job4	0.559
30	job20	0.565	job20	0.559
31	job24	0.261	job23	0.732
32	job44	0.522	job31	0.858
33	job14	0.652	job14	0.622
34	job9	0.522	job9	0.181
35	job35	0.913	job35	0.874
36	job18	0.913	job18	0.874
37	job33	0.913	job33	0.874
38	job48	0.565	job24	0
39	job17	0.696	job45	0.811
40	job8	0.783	job28	0.874
41	job23	0.652	job16	0.858
42	job42	0.783	job42	0.843
43	job16	0.913	job5	0.874
44	job27	0.87	job27	0.929
45	job3	0.957	job3	0.992
46	job26	0.87	job26	0.969
47	job25	0.391	job25	0.669
48	job1	0.652	job1	0.622
49	job15	0.522	job15	0.118
50	job5	0.609	job17	0.441
Total		37.006		35.04

Table 105: Average Absolute Difference from Baseline for Decision Maker 1

	-20%	-15%	-10%	-5%	0%	5%	10%	15%	20%
Grade	0.057	0.048	0.033	0.017	0.000	0.004	0.024	0.030	0.049
ASC	0.146	0.106	0.075	0.040	0.000	0.030	0.070	0.102	0.133
SC	0.008	0.009	0.003	0.002	0.000	0.004	0.011	0.002	0.008
Experience Level	0.122	0.089	0.063	0.034	0.000	0.025	0.058	0.085	0.111
Training Level	0.341	0.252	0.174	0.090	0.000	0.083	0.163	0.259	0.343
DT Vector	0.403	0.296	0.201	0.097	0.000	0.089	0.179	0.260	0.344
Officer Preference	0.042	0.030	0.022	0.008	0.000	0.000	0.002	0.013	0.013

Table 106: Average Absolute Difference from Baseline for Decision Maker 2

	-20%	-15%	-10%	-5%	0%	5%	10%	15%	20%
Grade	0.004	0.001	0.002	0.005	0.000	0.001	0.003	0.003	0.014
ASC	0.651	0.491	0.322	0.158	0.000	0.165	0.328	0.495	0.663
SC	0.016	0.013	0.009	0.005	0.000	0.003	0.003	0.004	0.005
Experience Level	0.029	0.024	0.017	0.000	0.000	0.012	0.021	0.032	0.026
Training Level	0.020	0.009	0.002	0.000	0.000	0.004	0.012	0.009	0.024
DT Vector	0.491	0.372	0.252	0.118	0.000	0.114	0.235	0.357	0.474
Officer Preference	0.045	0.032	0.020	0.011	0.000	0.005	0.014	0.021	0.029

Table 107: Average Identical Job Assignments for Decision Maker 1

	-20%	-15%	-10%	-5%	0%	5%	10%	15%	20%
Grade	36	36	39	38	50	38	37	39	36
ASC	35	37	35	36	50	37	37	38	37
SC	41	36	39	35	50	39	42	35	38
Experience Level	34	36	34	35	50	41	39	37	39
Training Level	37	36	36	35	50	38	36	39	38
DT Vector	35	31	32	34	50	36	34	35	33
Officer Preference	33	36	39	38	50	38	37	39	32

Table 108: Average Identical Job Assignments for Decision Maker 2

	-20%	-15%	-10%	-5%	0%	5%	10%	15%	20%
Grade	45	47	50	43	50	45	45	45	43
ASC	42	44	39	45	50	44	41	40	37
SC	38	44	45	46	50	45	43	43	40
Experience Level	47	42	47	44	50	43	43	45	42
Training Level	45	41	42	50	50	46	44	46	46
DT Vector	44	46	45	40	50	49	44	45	40
Officer Preference	45	47	50	43	50	45	45	45	41

Appendix J: Decision Maker 1 Interview Summary for 4-Attribute Case

Four different criteria shown below are desirable qualifications an officer might possess. These qualifications determine a "goodness of fit" between an assignment and a potential officer. We can assign a 1 or 0 for each desirable qualification an officer meets for each assignment. Although, we do not assume that each desirable qualification is important as another. So, we wish to develop a relative weighting scheme to apply to each criteria.

To determine the weighting scheme, we use the following method:

Step 1: Order the alternatives in order of importance from highest to lowest. Once finished, press the button below.

	Order
Experience and Training	1
DT Vector	2
Officer Preferences	2
Academic Specialty Code	3

Rank Order Finished?

Step 2: Next, three sets of two alternatives, Alternative A and Alternative B are presented.

The first alternative has one criteria set at its most preferred level and all other criteria set at their least preferred level (i.e., An officer meets one only desirable qualification). The second alternative has different criteria set at its most preferred level and all other criteria set at their least preferred levels.

As the decision maker, how important is **Alternative A** compared to **Alternative B** (i.e. is Alternative A 2 times more important than Alternative B or is Alternative B 3 times more important than Alternative A)?

		Most Preferred Attribute	Relative Importance Factor
Set 1	Alternative A	Experience and Training	2.00
	Alternative B	DT Vector	
Set 2	Alternative A	DT Vector	1.00
	Alternative B	Officer Preferences	
Set 3	Alternative A	Officer Preferences	2.00
	Alternative B	Academic Specialty Code	

Appendix K: Decision Maker 2 Interview Summary for 4-Attribute Case

Four different criteria shown below are desirable qualifications an officer might possess. These qualifications determine a "goodness of fit" between an assignment and a potential officer. We can assign a 1 or 0 for each desirable qualification an officer meets for each assignment. Although, we do not assume that each desirable qualification is important as another. So, we wish to develop a relative weighting scheme to apply to each criteria.

To determine the weighting scheme, we use the following method:

Step 1: Order the alternatives in order of importance from highest to lowest. Once finished, press the button below.

	Order
Experience and Training	1
Academic Specialty Code	2
DT Vector	3
Officer Preferences	4

Rank Order Finished?

Step 2: Next, three sets of two alternatives, Alternative A and Alternative B are presented.

The first alternative has one criteria set at its most preferred level and all other criteria set at their least preferred level (i.e., An officer meets one only desirable qualification). The second alternative has different criteria set at its most preferred level and all other criteria set at their least preferred levels.

As the decision maker, how important is **Alternative A** compared to **Alternative B** (i.e. is Alternative A 2 times more important than Alternative B or is Alternative B 3 times more important than Alternative A)?

		Most Preferred Attribute	Relative Importance Factor
Set 1	Alternative A	Experience and Training	2.00
	Alternative B	Academic Specialty Code	
Set 2	Alternative A	Academic Specialty Code	2.00
	Alternative B	DT Vector	
Set 3	Alternative A	DT Vector	2.00
	Alternative B	Officer Preferences	

Appendix L: AADIM-U Results: 4-Attribute Case

Tables 109 – 112 show the individual assignment pairings for each decision maker in the four-attribute case. Tables 113 – 116 show the average absolute difference from the baseline and average identical assignment matching for each decision maker in the four-attribute case.

Table 109: AADIM-U Results for Data Set 1

	Decision Maker 1		Decision Maker 2	
Officer	Assignment	Value Score	Assignment	Value Score
1	job28	0.778	job28	0.867
2	job25	0.778	job25	0.867
3	job40	0.778	job40	0.867
4	job34	0.778	job34	0.867
5	job31	0.667	job31	0.6
6	job42	0.778	job42	0.867
7	job48	0.556	job2	0.4
8	job9	0	job47	0
9	job13	0.667	job13	0.667
10	job15	0.778	job15	0.867
11	job12	0	job9	0
12	job5	0.556	job23	0.4
13	job16	0.778	job1	0.933
14	job50	0	job12	0
15	job49	0.778	job49	0.867
16	job4	0.667	job4	0.667
17	job39	0.778	job5	1
18	job27	0.778	job27	0.867
19	job30	0.778	job30	0.867
20	job41	0.778	job41	0.867
21	job43	0.889	job43	0.733
22	job18	0.111	job50	0.267
23	job19	0.556	job39	0.8
24	job37	0.778	job37	0.867
25	job32	0.778	job32	0.867
26	job47	0	job16	0
27	job1	0.444	job18	0.4
28	job20	0.778	job20	0.867
29	job17	0.778	job17	0.867
30	job2	0.778	job48	1
31	job11	0.778	job11	0.933
32	job6	1	job6	1
33	job35	0.333	job35	0.333
34	job38	0.778	job38	0.867
35	job3	0.778	job3	0.933

36	job33	0.778	job33	0.867
37	job36	0.778	job36	0.867
38	job45	0.667	job45	0.6
39	job14	0.889	job14	0.733
40	job44	0	job44	0
41	job46	0.778	job46	0.867
42	job26	1	job26	1
43	job7	0.556	job7	0.467
44	job8	0.556	job8	0.8
45	job23	0.556	job19	0.8
46	job10	0.889	job24	0.933
47	job22	0.778	job22	0.933
48	job24	0.556	job10	0.6
49	job29	0.778	job29	0.867
50	job21	0.889	job21	0.733
Total		32.454		35.138

Table 110: AADIM-U Results for Data Set 2

	Decision Maker 1		Decision Maker 2	
Officer	Assignment	Value Score	Assignment	Value Score
1	job46	0.333	job38	0.4
2	job44	0.778	job3	0.933
3	job29	1	job29	1
4	job3	0.556	job48	0.933
5	job27	0.556	job27	0.467
6	job30	0.333	job46	0.267
7	job36	0.778	job5	0.867
8	job33	0.556	job33	0.8
9	job28	0	job24	0
10	job45	0.667	job7	0.933
11	job47	0.667	job44	0.8
12	job42	0.778	job2	0.8
13	job19	1	job19	1
14	job1	0.333	job1	0.333
15	job48	0.556	job4	0.533
16	job50	0.333	job50	0.4
17	job14	0.778	job14	0.867
18	job23	0.778	job23	0.867
19	job18	0.667	job11	0.933
20	job6	0.667	job6	0.6
21	job15	0.778	job31	0.8
22	job13	0.889	job13	0.733
23	job17	0.556	job28	0.8
24	job40	0.778	job40	0.867
25	job49	0.556	job49	0.467
26	job22	0	job20	0
27	job37	1	job37	1
28	job10	0.778	job10	0.867
29	job2	0.556	job18	0.8

30	job21	0.778	job21	0.867
31	job38	0.778	job34	0.867
32	job7	0.778	job22	0.8
33	job41	0	job45	0
34	job32	0.778	job32	0.867
35	job20	0.667	job30	0.867
36	job34	0.778	job17	0.8
37	job16	0.778	job16	0.933
38	job5	0.778	job41	0.8
39	job25	0.667	job25	0.6
40	job43	1	job43	1
41	job9	1	job9	1
42	job26	0.556	job26	0.8
43	job31	0.556	job15	0.867
44	job39	0.778	job39	0.867
45	job8	0.222	job8	0.067
46	job4	0.444	job47	0.533
47	job12	0.778	job12	0.867
48	job11	0.667	job42	0.8
49	job35	0.778	job35	0.867
50	job24	0.667	job36	0.867
Total		32.231		36.003

Table 111: AADIM-U Results for Data Set 3

	Decision Maker 1		Decision Maker 2	
Officer	Assignment	Value Score	Assignment	Value Score
1	job45	1	job45	1
2	job16	0.667	job4	0.933
3	job6	0.778	job16	0.667
4	job18	0.778	job18	0.867
5	job21	0.667	job23	0.867
6	job37	0.556	job41	0.8
7	job15	0.333	job13	0.067
8	job19	0.667	job10	0.8
9	job17	0.778	job17	0.867
10	job27	0.222	job37	0.4
11	job11	0.778	job11	0.933
12	job1	0.333	job40	0.333
13	job39	0.778	job39	0.933
14	job14	0.556	job6	0.467
15	job3	0.667	job3	0.6
16	job25	0.333	job19	0
17	job36	0.333	job36	0.333
18	job29	0.667	job49	0.867
19	job32	1	job32	1
20	job2	0.556	job5	0.867
21	job4	0.889	job31	0.867
22	job38	0.778	job38	0.933
23	job34	0.333	job14	0.333

24	job23	0.778	job25	0.867
25	job44	0.556	job33	0.8
26	job40	0.333	job15	0.4
27	job24	0.778	job24	0.867
28	job28	0.778	job28	0.867
29	job48	0.778	job2	0.8
30	job12	0.778	job12	0.867
31	job46	0.778	job34	0.933
32	job31	0.778	job21	0.867
33	job26	1	job26	1
34	job8	0.889	job50	0.6
35	job41	0.333	job29	0.133
36	job22	0.778	job22	0.867
37	job9	1	job9	1
38	job20	1	job20	1
39	job7	0.778	job46	0.933
40	job33	0.778	job44	0.933
41	job10	0.556	job7	0.867
42	job47	0.778	job47	0.867
43	job42	0.778	job42	0.867
44	job30	0.556	job30	0.8
45	job43	0.778	job43	0.867
46	job13	0.667	job27	0.6
47	job5	0.778	job8	0.733
48	job50	0.667	job1	0.867
49	job35	1	job35	1
50	job49	0.778	job48	0.867
Total		34.674		37.803

Table 112: AADIM-U Results for Data Set 4

	Decision Maker 1		Decision Maker 2	
Officer	Assignment	Value Score	Assignment	Value Score
1	job33	0.778	job24	0.667
2	job32	0.778	job32	0.867
3	job47	0.222	job49	0.4
4	job49	0.333	job38	0.4
5	job36	0.444	job36	0.2
6	job7	0.889	job7	0.733
7	job12	0.667	job33	0.867
8	job34	0.778	job34	0.867
9	job11	0.667	job47	0.667
10	job19	0.778	job19	0.867
11	job2	0.333	job25	0.333
12	job13	0.778	job40	0.867
13	job44	0.222	job2	0.4
14	job50	1	job50	1
15	job29	0.778	job29	0.867
16	job20	0	job13	0.267
17	job37	0.778	job37	0.867

18	job39	0.556	job39	0.467
19	job41	0.222	job41	0.133
20	job42	1	job42	1
21	job30	0.778	job30	0.867
22	job48	0.778	job48	0.867
23	job10	0.778	job10	0.867
24	job38	0.778	job8	0.6
25	job43	1	job43	1
26	job21	0.778	job21	0.867
27	job46	0.778	job46	0.867
28	job22	1	job22	1
29	job23	1	job12	0.6
30	job28	0.778	job11	0.6
31	job24	0.667	job23	1
32	job31	0.778	job31	0.867
33	job14	0.778	job14	0.867
34	job9	0.667	job9	0.667
35	job35	0.778	job35	0.867
36	job18	0.778	job18	0.867
37	job17	0.667	job44	0.667
38	job6	0.778	job6	0.867
39	job45	0.556	job45	0.8
40	job8	0.667	job28	0.867
41	job16	0.778	job5	0.867
42	job15	0.222	job15	0.067
43	job25	0.778	job16	0.867
44	job27	0.778	job27	0.933
45	job3	1	job3	1
46	job26	0.556	job26	0.467
47	job5	1	job20	0.933
48	job1	0.778	job1	0.867
49	job4	0.556	job4	0.8
50	job40	0.556	job17	0.2
Total		34.563		36.208

Table 113: Average Absolute Difference from Baseline for Decision Maker 1

	-20%	-15%	-10%	-5%	0%	5%	10%	15%	20%
ASC	0.121	0.091	0.063	0.034	0.000	0.042	0.067	0.115	0.158
Experience and Training Level	0.872	0.642	0.437	0.229	0.000	0.210	0.448	0.664	0.883
DT Vector	1.123	0.846	0.555	0.279	0.000	0.212	0.417	0.642	0.843
Officer Preference	0.098	0.069	0.058	0.032	0.000	0.093	0.203	0.320	0.432

Table 114: Average Absolute Difference from Baseline for Decision Maker 2

	-20%	-15%	-10%	-5%	0%	5%	10%	15%	20%
ASC	0.506	0.389	0.257	0.135	0.000	0.122	0.260	0.381	0.502
Experience and Training Level	1.054	0.785	0.526	0.266	0.000	0.267	0.521	0.781	1.049
DT Vector	0.501	0.386	0.252	0.115	0.000	0.122	0.260	0.373	0.507
Officer Preference	0.003	0.002	0.007	0.008	0.000	0.001	0.000	0.009	0.009

Table 115: Average Identical Job Assignments for Decision Maker 1

	-20%	-15%	-10%	-5%	0%	5%	10%	15%	20%
ASC	35	37	37	37	50	32	35	37	37
Experience and Training Level	36	32	40	37	50	31	32	34	35
DT Vector	31	30	32	31	50	31	30	30	28
Officer Preference	30	30	32	31	50	29	29	29	31

Table 116: Average Identical Job Assignments for Decision Maker 2

	-20%	-15%	-10%	-5%	0%	5%	10%	15%	20%
ASC	29	30	37	37	50	36	42	36	33
Experience and Training Level	36	33	32	40	50	36	31	36	36
DT Vector	36	33	37	35	50	32	35	35	35
Officer Preference	36	33	31	34	50	37	35	37	37

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

This research develops the Advanced Academic Degree (AAD) Inventory Model (AADIM) to employ an inventory management approach to select, educate, and assign officers to duties that require incumbents possessing advanced education in specialized technical disciplines. The AADIM offers an alternative approach to the US Air Force's current billet-based Graduate Education Management System (GEMS).

The entry model (AADIM-E) generates, via user inputs, a career field specific advanced education profile and then employs a Markov model to forecast the educational quotas necessary to achieve the desired profile within a prescribed period of time. The utilization model (AADIM-U) uses an additive multi-attribute value function to ascribe a qualification score, based on a selected set of weighted criteria, to each officer with respect to each available duty assignment. An integer programming formulation is then solved to obtain an optimal matching between officers and assignments that maximizes the summed qualification scores.

The research demonstrates that AADIM-E can be used to evaluate the feasibility and practicality of long-term policies such as career field manning, the desired proportion and timing of officers requiring advanced education, as well as the length of time allowed to achieve such goals. The AADIM-U yields an objective methodology to manage AAD officers, as long-term inventory assets, to yield substantially greater incumbency rates for AAD positions than historically achieved using the current GEMS process.

15. SUBJECT TERMS

Inventory Model, Markov Model, Assignment Problem, Forecasting Model, Multi-Attribute Value Function Decision Analysis, Network Models, Exponential Smoothing Methods, Integer Program, Stochastic System

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